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REPORT

University of Wis.

OF THE Military Department,

TESTS OF METALS

AND

OTHER MATERIALS

FOR

INDUSTRIAL PURPOSES

MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL,
MASSACHUSETTS,

DURING THE

FISCAL YEAR ENDED JUNE 30, 1904.

WASHINGTON:
GOVERNMENT PRINTING OFFICE,
1905.

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LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ORDNANCE, A REPORT OF TESTS OF IRON AND STEEL AND OTHER MATERIALS AT THE WATERTOWN ARSENAL DURING THE YEAR ENDED JUNE 30, 1904.

War Department,
Washington, February 2, 1905.

Sir: I have the honor to transmit herewith a letter from the Chief of Ordnance, U. S. Army, dated January 30 ultimo, submitting for transmission to Congress, as required by law, copy of a report of the commanding officer at the Watertown Arsenal, of "tests of iron and steel and other material for industrial purposes," made at the said arsenal during the fiscal year ended June 30, 1904.

Very respectfully,

Wm. H. Taft, *Secretary of War.*

The Speaker of the House of Representatives.

Office of the Chief of Ordnance,
Washington, January 30, 1905.

Sir: I have the honor to submit, for transmission to Congress as required by law, a copy of the report of the commanding officer, Watertown Arsenal, of "tests of iron and steel and other material for industrial purposes," made at that arsenal during the fiscal year ended June 30, 1904, which has just been received at this office.

Very respectfully,

William Crozier,
Brig. Gen., Chief of Ordnance.

The honorable Secretary of War.

WATERTOWN ARSENAL,
Watertown, Mass., January 28, 1905.

SIR: I have the honor to submit herewith the annual report of tests of iron and steel and other materials made at this arsenal during the fiscal year ended June 30, 1904.

The total number of specimens tested during the year was classified as follows:

Gun specimens	129
For Ordnance Department	2,231
For other Government departments	59
Investigative tests	538
Tests for private parties	762
Total	3,719

The receipts and expenditures were as follows:

Amount appropriated for testing machine and testing work	$15,000.00
Received from private parties during the year	1,874.64
Total received	16,874.64
Amount expended for services and labor	13,206.12
Amount expended for light, power, tools, implements, and materials for test	3,645.98
Deposited to credit of Treasurer United States	22.54
Total expended	16,874.64

Much of the routine work of the testing department during the past fiscal year has pertained to arsenal material. The Tropenas steel casting plant, the iron and bronze foundry, and the smith shop have each contributed material which has been tested, preliminary to its acceptance for current work in the arsenal shops, and has represented some work done for other arsenals. Specimens from gun forgings have been received from steel works engaged in supplying material for the Ordnance Department. Bars have been tested for comparison of testing machines in use at domestic and foreign manufacturing establishments where ordnance work is being done.

Generally this work came within the capacity of the 100,000-pound testing machine, which consequently is utilized for this class of testing, leaving the 800,000-pound machine available for special departmental work and investigative tests on industrial material, and to meet the demands of individuals for whom tests are made at their request and expense, in accordance with a provision of the law.

Tests on ordnance material have been made on each of 234 days during the past year. Further examination has been made of the metal in gun forgings which has shown the presence of streaks therein. Proof stresses have been applied to piston rods and retraction ropes. Helical springs, copper cylinders for pressure gauges in the determination of powder pressures, mountain gun carriage wheels and axle, and gun wire are among the testing done on account of the Ordnance Department.

Additional tests have been made of the metal from a carbon-steel ingot of the grade of steel used in gun forgings. The tests were with specimens which had been forged at different temperatures, some of which were afterwards subjected to heat treatment. There have been retests of wrought iron, following a period of rest of twenty-two years, which has intervened since the original tests were made. Tensile properties characteristic of the earlier overstraining loads still remain in the iron at the present time.

The inquiry of previous years into the properties of cements, mortars, and concretes has been continued and extended to the tests of columns 1 foot square in cross section by 8 feet in height. The columns represent different combinations of the ingredients—cement, sand, and stone—and there were plain columns and those reenforced with longitudinal steel bars. Brick piers of corresponding size were built and tested, representing some of the constructive material of this class produced in the New England States. Comprised in these tests were piers built of dry pressed, repressed, and wire cut mud bricks, also hard and light hard common sand struck brick. A few tests were made upon sand-lime brick.

Wooden posts representing the principal constructive timber of the country are represented by a number of sticks, and some of these, having been tested to their ultimate strength, together with representative brick piers and concrete columns, were sent to the Louisiana Purchase Exposition at St. Louis as a part of the testing department exhibit.

Tests on the endurance of steel bars to repeated alternate stresses have been continued. In the present testing apparatus the maximum fiber stresses are applied at the rate of 500 times per minute. Means are being provided for subjecting the experimental shafts to very rapid alternations of stresses. A steam turbine having a normal rated speed of 38,000 rotations per minute will be used for the purpose.

Chemical analyses are entered in the details of the tests with the material to which they pertain.

A list of private parties for whom tests have been made on individual account is appended to the report.

Very respectfully, your obedient servant,

Frank Baker,
Major, Ordnance Department, U. S. Army, Commanding.

The Chief of Ordnance, U. S. Army,
Washington, D. C.

REPORT

OF THE

TESTS OF METALS AND OTHER MATERIALS

FOR

INDUSTRIAL PURPOSES,

MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL,
MASSACHUSETTS,

DURING THE

FISCAL YEAR ENDED JUNE 30, 1904.

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15-POUNDER R. F. GUNS.

SPECIMENS FROM TUBES, JACKETS, BREECHBLOCK, AND BREECH BUSHING.

TUBE.

No. 7799.

Marks, $^{32015\ B_1\ F_1}_{B\ T_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00030	....	....	
30,000	.00105	.00065	....	....	
40,000	.00140	.00035	....	....	
50,000	.00185	.00045	0.	0.	
51,000	.00190	.00005	....	....	
52,000	.00195	.00005	....	....	
53,000	.00200	.00005	....	....	Elastic limit.
54,000	.00345	.00145	....	....	
55,000	.00400	.00055	....	....	
56,000	.00725	.00325	....	....	
92,700	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section........pounds..	92,700
Elastic limit per square inch of original section........do...	53,000
Elongation per inch after rupture........inch..	.230
Elongation per inch under strain at elastic limit........do...	.00200
Reduction in diameter at point of rupture........do...	.155
Reduction in area after rupture, per cent of original section........	51.9
Position of rupture........	″.90 from neck
Character of broken surface........	fine silky
Elongation of inch sections........	″.34*, ″.12

TUBE.

No. 7800.

Marks, $^{32322\ B_1\ F_1}_{B\ T_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00100	.00065	....	....	
40,000	.00130	.00030	....	....	
50,000	.00165	.00035	0.	0.	
59,000	.00195	.00030	....	....	Elastic limit.
60,000	.00300	.00105	....	....	
61,000	.00715	.00415	....	....	
62,000	.00825	.00110	....	....	
97,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section........pounds..	97,500
Elastic limit per square inch of original section........do...	59,000
Elongation per inch after rupture........inch..	.210
Elongation per inch under strain at elastic limit........do...	.00195
Reduction in diameter at point of rupture........do...	.105
Reduction in area after rupture, per cent of original section........	37.1
Position of rupture........	1″.12 from neck
Character of broken surface........	granular, in part silky
Elongation of inch sections........	″.28*, ″.14

TUBE.

No. 7801.

Marks, $^{32930\ B_1\ F_1}_{B\ T_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025			
30,000	.00100	.00065			
40,000	.00135	.00035			
50,000	.00170	.00035	0.	0.	
58,000	.00200	.00030			
59,000	.00205 .00765	.00005 .00560			Elastic limit.
60,000	.00840	.00075			
61,000	.00930	.00090			
99,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	99,000
Elastic limit per square inch of original section	do	59,000
Elongation per inch after rupture	inch	.235
Elongation per inch under strain at elastic limit	do	.00205
Reduction in diameter at point of rupture	do	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		1″.07 from neck
Character of broken surface		silky
Elongation of inch sections		″.30*, ″.17

TUBE.

No. 7815.

Marks, $^{32316\ B_1\ F_1}_{B\ T_4M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025			
30,000	.00100	.00065			
40,000	.00140	.00040			
50,000	.00170	.00030	0.	0.	
56,000	.00200	.00030			Elastic limit.
57,000	.00270	.00070			
58,000	.00350	.00080			
59,000	.00500	.00150			
60,000	.00685	.00185			
103,200					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	103,200
Elastic limit per square inch of original section	do	56,000
Elongation per inch after rupture	inch	.195
Elongation per inch under strain at elastic limit	do	.00200
Reduction in diameter at point of rupture	do	.095
Reduction in area after rupture, per cent of original section		34.0
Position of rupture		″.45 from neck
Character of broken surface		granular, 60 per cent; silky, 40 per cent
Elongation of inch sections		″.24*, ″.15

TUBE.

No. 7817.

Marks, $^{32939\ B_1\ F_1}_{B\ T.M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00100	.00065	....	....	
40,000	.00140	.00040	....	....	
49,000	....	....	....	....	Elastic limit, approximate.
50,000	.00210	.00070	.00040	.00040	
51,000	.00285	.00075	....	....	
52,000	.00360	.00075	....	....	
53,000	.00510	.00150	....	....	
54,000	.00725	.00215	....	....	
55,000	.00800	.00075	....	....	
99,400	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	99,400
Elastic limit per square inch of original section (approximate)	do...	49,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	......
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		″.70 from neck
Character of broken surface		granular; silky spot at circumference
Elongation of inch sections		″.26*, ″.12

TUBE.

No. 7984.

Marks, $^{42238\ B_1\ F_2}_{B\ T.M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	....	....	
30,000	.00080	.00060	....	....	
50,000	.00145	.00065	0.	0.	
55,000	.00170	.00025	....	....	
60,000	.00190	.00020	....	....	
62,000	.00200	.00010	....	....	Elastic limit.
63,000	.00500	.00300	....	....	
64,000	.00650	.00150	....	....	
65,000	.00780	.00130	....	....	
66,000	.00965	.00125	....	....	
104,750	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,750
Elastic limit per square inch of original section	do...	62,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00200
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37,1
Position of rupture		″.85 from neck
Character of broken surface		silky
Elongation of inch sections		″.14, ″.28*

TUBE.

No. 8001.

Marks, $\substack{41914\ B_2\ F_2 \\ B\ T.M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00090	.00065	....	....	
40,000	.00125	.00035	....	....	
50,000	.00155	.00030	0.	0.	
55,000	.00175	.00020	....	....	
60,000	.00190	.00015	....	....	
64,000	.00200	.00010	....	....	Elastic limit.
65,000	.00570	.00370	....	....	
66,000	.00735	.00165	....	....	
67,000	.00920	.00185	....	....	
104,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	104,500
Elastic limit per square inch of original section	do	64,000
Elongation per inch after rupture	inch	.180
Elongation per inch under strain at elastic limit	do	.00200
Reduction in diameter at point of rupture	do	.075
Reduction in area after rupture, per cent of original section		27.4
Position of rupture		″.7 from neck
Character of broken surface		granular, 70 per cent; silky, 30 per cent
Elongation of inch sections		″.12, ″.24*

JACKET.

No. 7802.

Marks, $\substack{36062\ B_1 \\ B\ T_1 M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00095	.00060	....	....	
40,000	.00130	.00035	....	....	
50,000	.00160	.00030	0.	0.	
56,000	.00180	.00020	....	....	Elastic limit.
57,000	.00300	.00120	....	....	
58,000	.01095	.00795	....	....	
59,000	.01200	.00105	....	....	
93,000	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	93,000
Elastic limit per square inch of original section	do	56,000
Elongation per inch after rupture	inch	.220
Elongation per inch under strain at elastic limit	do	.00180
Reduction in diameter at point of rupture	do	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		1″.11 from neck
Character of broken surface		silky, oblique
Elongation of inch sections		″.28,* ″.16

JACKET.

No. 7803.

Marks, $\overset{36125\ B_4}{B\ T_1 M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00100	.00065	....	....	
40,000	.00145	.00045	....	....	
50,000	.00170	.00025	0.	0.	
59,000	.00205	.00035	....	....	Elastic limit.
60,000	.00350	.00145	....	....	
61,000	.00500	.00150	....	....	
62,000	.00650	.00150	....	....	
99,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	99,500
Elastic limit per square inch of original section	do...	59,000
Elongation per inch after rupture	inch..	.215
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		".65 from neck
Character of broken surface		silky
Elongation of inch sections		".10, ".33*

JACKET.

No. 7804.

Marks, $\overset{36366\ B_2}{B\ T_1 M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00105	.00070	....	....	
40,000	.00140	.00035	....	....	
50,000	.00180	.00040	0.	0.	
60,000	.00210	.00030	....	....	Elastic limit.
61,000	.00950	.00740	....	....	
62,000	.01000	.00050	....	....	
63,000	.01100	.00100	....	....	
96,000	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	96,000
Elastic limit per square inch of original section	do...	60,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00210
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		".7 from neck
Character of broken surface		silky
Elongation of inch sections		".20*, ".13

JACKET.

No. 7807.

Marks, $\overset{38411\ B_6}{B\ T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00045	.00035	....	....	
30,000	.00095	.00050	....	....	
40,000	.00125	.00030	....	....	
50,000	.00160	.00035	0.	0.	
60,000	.00200	.00040	....	....	
61,000	.00205	.00005	....	....	Elastic limit.
62,000	.00400	.00195	....	....	
63,000	.00900	.00500	....	....	
64,000	.01050	.00150	....	....	
97,100	....	....	....	....	Tensile strength.

General summary.

Tensile strength, per square inch of original section	pounds..	97,100
Elastic limit, per square inch of original section	do...	61,000
Elongation per inch after rupture	inch..	.105
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.025
Reduction in area after rupture, per cent of original section		9.5
Position of rupture		".90 from neck
Character of broken surface		fine granular
Elongation of inch sections		".12*,".09

JACKET.

No. 7816.

Marks, $\overset{36062\ B_6}{B\ T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00100	.00065	....	....	
40,000	.00135	.00035	....	....	
50,000	.00165	.00030	0.	0.	
54,000	.00185	.00020	....	....	Elastic limit.
55,000	.00550	.00365	....	....	
56,000	.00595	.00045	....	....	
57,000	.00645	.00050	....	....	
58,000	.00700	.00055	....	....	
104,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength, per square inch of original section	pounds..	104,500
Elastic limit, per square inch of original section	do...	54,000
Elongation per inch after rupture	inch..	.150
Elongation per inch under strain at elastic limit	do...	.00185
Reduction in diameter at point of rupture	do...	.045
Reduction in area after rupture, per cent of original section		16.9
Position of rupture		at the neck
Character of broken surface		granular
Elongation of inch sections		".14,".16

JACKET.

No. 7993.

Marks, $\overset{40246\ B_1}{B\ T_1M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00025	.00010	....	....	
30,000	.00085	.00060	....	....	
40,000	.00120	.00035	....	....	
50,000	.00150	.00030	0.	0.	
55,000	.00170	.00020	....	....	
59,000	.00180	.00010	....	....	Elastic limit.
60,000	.00405	.00225	....	....	
61,000	.00510	.00105	....	....	
62,000	.00575	.00065	....	....	
104,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength, per square inch of original section..........pounds.. 104,500
Elastic limit, per square inch of original section..........do... 59,000
Elongation per inch after rupture..........inch.. .180
Elongation per inch under strain at elastic limit..........do... .00180
Reduction in diameter at point of rupture..........do... .075
Reduction in area after rupture, per cent of original section.......... 27.4
Position of rupture.......... 1″ from neck
Character of broken surface...... granular, 60 per cent; silky, serrated, 40 per cent; opened cracks in stem in vicinity of fracture.
Elongation of inch sections.......... ″.12, ″.24*

BREECHBLOCK.

No. 7865.

Marks, $\overset{19967}{T_1M}\ B_1\ T_1\ O$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
30,000	.00105	.00090	....	....	
50,000	.00190	.00085	0.	0,	
65,000	.00230	.00040	....	....	
70,000	.00250	.00020	....	....	
75,000	.00265	.00015	....	....	
79,000	.00290	.00025	....	....	Elastic limit.
80,000	.00725	.00435	....	....	
81,000	.00815	.00090	....	....	
82,000	.00925	.00110	....	....	
83,000	.01000	.00075	....	....	
84,000	01050	.00050	....	....	
122,000	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds.. 122,000
Elastic limit per square inch of original section.......... do... 79,000
Elongation per inch after rupture..........inch.. .180
Elongation per inch under strain at elastic limit..........do... .00290
Reduction in diameter at point of rupture..........do... .115
Reduction in area after rupture, per cent of original section.......... 40.3
Position of rupture.......... 1″ from neck
Character of broken surface.......... silky
Elongation of inch sections.......... ″.11, ″.25*

BREECH BUSHING.

No. 7813.

Marks, $\overset{33141\ B_3\ F_1}{B\ T_2\ M}$

Diameter, ″.505.

Sectional area, .20 square inch.

Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
30,000	.00100	.00090	....	....	
50,000	.00175	.00075	0.	0.	
59,000	.00205	.00030	....	....	Elastic limit.
60,000	.01125	.00920	....	....	
61,000	.01190	.00065	....	....	
62,000	.01250	.00060	....	....	
101,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	101,500
Elastic limit per square inch of original section	do...	59,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		″.75 from neck
Character of broken surface		fine granular, radiating from silky spot at circumference
Elongation of inch sections		″.12, ″.25*

TABULATION OF TENSION SPECIMENS FROM 15-POUNDER R. F. GUNS.

STEMS 2″ LONG; ″.505 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
7799	Tube	Middle.	53,000	92,700	23.0	51.9	Fine silky	Breech end.
7800	.....do	...do...	59,000	97,500	21.0	37.1	Granular; in part silky.	Do.
7801	.....do	...do...	59,000	99,000	23.5	46.2	Silky	Do.
7815	.....do	...do...	56,000	103,200	19.5	34.0	Granular, 60 per cent; silky, 40 per cent.	Do.
7817	.....do	...do...	[a] 49,000	99,400	19.0	30.7	Granular silky spot.	Do.
7984	.....do	...do...	62,000	104,750	21.0	37.1	Silky	Do.
8001	.....do	...do...	64,000	104,500	18.0	27.4	Granular, 70 per cent; silky, 30 per cent.	Do.
7802	Jacket	...do...	56,000	93,000	22.0	37.1	Silky; oblique	Do.
7803	.....do	...do...	59,000	90,500	21.5	43.3	Silky	Do.
7804	.....do	...do...	60,000	96,000	21.0	43.3	....do	Do.
7807	.....do	...do...	61,000	97,100	10.5	9.5	Fine granular	Do.
7816	.....do	...do...	54,000	104,500	15.0	16.9	Granular	Do.
7993	.....do	...do...	59,000	104,500	18.0	27.4	Granular, 60 per cent; silky, serrated, 40 per cent; opened cracks in stem.	Do.
7865	Breechblock	...do...	79,000	122,000	18.0	40.3	Silky	
7813	Breech bushing.	...do...	59,000	101,500	18.5	30.7	Fine granular; silky spot.	Do.

[a] Approximate.

3-INCH R. F. GUNS.

SPECIMENS FROM TUBES, JACKETS, LOCKING HOOPS, AND BREECHBLOCKS.

TUBE.

No. 7818.

Marks, $\substack{18060\ B_1\ F_1 \\ B\ T_2 M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00030	....	....	
30,000	.00100	.00060	....	....	
40,000	.00140	.00040	....	....	
50,000	.00175	.00035	0.	0.	
60,000	.00205	.00030	....	....	
64,000	.00225	.00020	....	....	Elastic limit.
65,000	.00240 .00850	.00015 .00610	....	....	
66,000	.00945	.00095	....	....	
67,000	.01000	.00055	....	....	
68,000	.01100	.00100	....	....	
107,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	107,500
Elastic limit per square inch of original section	do...	64,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	.00225
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34.0
Position of rupture		″.75 from neck
Character of broken surface		silky
Elongation of inch sections		″.24* ″.14

TUBE.

No. 7929.

Marks, $\begin{smallmatrix}39492\ \mathrm{B}_2\\ \mathrm{B\ T}_1\mathrm{O}\end{smallmatrix}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00100	.00065	....	....	
40,000	.00140	.00040	....	....	
50,000	.00175	.00035	0.	0.	
60,000	.00210	.00035	....	....	
65,000	.00230	.00020	....	....	
70,000	.00250	.00020	....	....	
73,000	.00265	.00015	....	....	Elastic limit.
74,000	.00310	.00045	....	....	
75,000	.00515	.00205	....	....	
76,000	.00750	.00235	....	....	
110,600	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	110,600
Elastic limit per square inch of original section	do...	73,000
Elongation per inch after rupture	inch..	.180
Elongation per inch under strain at elastic limit	do...	.00265
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".95 from neck
Character of broken surface		silky
Elongation of inch sections		".10, ".26*

TUBE.
No. 7959.

Marks, $\genfrac{}{}{0pt}{}{39491\ B_2}{B\ T_4M}$

Diameter, ″.505.

Sectional area, .20 square inch.

Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	....	....	
30,000	.00075	.00055	....	....	
40,000	.00110	.00035	....	....	
50,000	.00145	.00035	0.	0.	
60,000	.00155	.00010	....	....	
65,000	.00210	.00055	....	....	
69,000	.00235	.00025	....	....	Elastic limit.
70,000	.00415	.00180	....	....	
71,000	.00925	.00510	....	....	
73,000	.01000	.00075	....	....	
106,050	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	106,050
Elastic limit per square inch of original section	do	69,000
Elongation per inch after rupture	inch	.210
Elongation per inch under strain at elastic limit	do	.00235
Reduction in diameter at point of rupture	do	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		″.7 from neck
Character of broken surface		silky
Elongation of inch sections		″.12, ″.30*

JACKET.
No. 7798.

Marks, $\genfrac{}{}{0pt}{}{36234\ B_2}{B\ T_1M}$

Diameter, ″.505.

Sectional area, .20 square inch.

Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00030	....	....	
30,000	.00105	.00065	....	....	
40,000	.00140	.00035	....	....	
50,000	.00185	.00045	0.	0.	
60,000	.00215	.00030	0.	0.	
66,000	.00250	.00035	....	....	Elastic limit.
67,000	.00260	.00010	....	....	
68,000	.00300	.00040	....	....	
69,000	.00450	.00150	....	....	
70,000	.00570	.00120	....	....	
112,100	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	112,100
Elastic limit per square inch of original section	do	66,000
Elongation per inch after rupture	inch	.195
Elongation per inch under strain at elastic limit	do	.00250
Reduction in diameter at point of rupture	do	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		″.85 from neck
Character of broken surface		silky
Elongation of inch sections		″.28*, ″.11

JACKET.

No. 7812.

Marks, $\genfrac{}{}{0pt}{}{36361\ B_1}{B\ T_1M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00030			
30,000	.00105	.00065			
40,000	.00140	.00035			
50,000	.00180	.00040	0.	0.	
60,000	.00215	.00035			
69,000	.00255	.00040			Elastic limit.
70,000	.00915	.00660			
71,000	.01020	.00105			
72,000	.01150	.00130			
109,500					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	109,500
Elastic limit per square inch of original section	do	69,000
Elongation per inch after rupture	inch	.220
Elongation per inch under strain at elastic limit	do	.00255
Reduction in diameter at point of rupture	do	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		″.9 from neck
Character of broken surface		silky
Elongation of inch sections		″.13, ″.31*

JACKET.

No. 7969.

Marks, $\genfrac{}{}{0pt}{}{40573\ B_1}{B\ T_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020			
30,000	.00105	.00070			
40,000	.00140	.00035			
50,000	.00185	.00045	0.	0.	
60,000	.00220	.00035			
70,000	.00260	.00040			
73,000	.00275	.00015			Elastic limit.
74,000	.01540	.01265			
75,000	.01625	.00085			
76,000	.01700	.00075			
105,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	105,000
Elastic limit per square inch of original section	do	73,000
Elongation per inch after rupture	inch	.245
Elongation per inch under strain at elastic limit	do	.00275
Reduction in diameter at point of rupture	do	.145
Reduction in area after rupture, per cent of original section		49.1
Position of rupture		at middle of stem
Character of broken surface		fine silky
Elongation of inch sections		″.23, ″.26*

JACKET.

No. 7983.

Marks, $\begin{smallmatrix}42511\ B_1\\ B\ T_1M\end{smallmatrix}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	....	....	
30,000	.00090	.00060	....	....	
40,000	.00125	.00035	....	....	
50,000	.00155	.00030	0.	0.	
55,000	.00175	.00020	....	....	
60,000	.00190	.00015	....	....	
65,000	.00205	.00015	....	....	
68,000	.00230	.00025	....	....	Elastic limit.
69,000	.00330	.00100	....	....	
70,000	.00345	.00015	....	....	
71,000	.00380	.00035	....	....	
72,000	.00525	.00145	....	....	
73,000	.00695	.00170	....	....	
111,000	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	111,000
Elastic limit per square inch of original section	do	68,000
Elongation per inch after rupture	inch	.200
Elongation per inch under strain at elastic limit	do	.00230
Reduction in diameter at point of rupture	do	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		″.75 from neck
Character of broken surface		silky
Elongation of inch sections		″.10, ″.30*

LOCKING HOOP.

No. 7960.

Marks, $\begin{matrix}40905\ B_3\ F_2\\ M\ T_2M\end{matrix}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00095	.00070	....	....	
40,000	.00135	.00040	....	....	
50,000	.00170	.00035	0.	0.	
60,000	.00205	.00035	....	....	
70,000	.00240	.00035	....	....	
80,000	.00275	.00035	....	....	
81,000	.00285	.00010	....	....	Elastic limit.
82,000	.00300	.00015	....	....	
83,000	.00365	.00065	....	....	
84,000	.00450	.00085	....	....	
85,000	.00530	.00080	....	....	
116,450	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	116,450
Elastic limit per square inch of original section	do	81,000
Elongation per inch after rupture	inch	.160
Elongation per inch under strain at elastic limit	do	.00285
Reduction in diameter at point of rupture	do	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		″.7 from neck
Character of broken surface		silky
Elongation of inch sections		″.23*, ″.09

LOCKING HOOP.

No. 7968.

Marks, $\genfrac{}{}{0pt}{}{36127\ B_2\ F_1}{B\ T_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length. 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	....	....	
30,000	.00105	.00070	....	....	
40,000	.00150	.00045	....	....	
50,000	.00175	.00025	0.	0.	
60,000	.00215	.00040	....	....	
70,000	.00255	.00040	....	....	
75,000	.00275	.00020	....	....	
80,000	.00295	.00020	....	....	
82,000	.00305	.00010	....	....	Elastic limit.
83,000	.00415	.00110	....	....	
84,000	.00515	.00100	....	....	
85,000	.00675	.00160	....	....	
115,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	115,500
Elastic limit per square inch of original section	do	82,000
Elongation per inch after rupture	inch	.175
Elongation per inch under strain at elastic limit	do	.00305
Reduction in diameter at point of rupture	do	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		".7 from neck
Character of broken surface		silky
Elongation of inch sections		".08, ".27*

BREECHBLOCK.

No. 7945.

Marks, $\genfrac{}{}{0pt}{}{89434\ B_1\ F_6}{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
40,000	.00150	.00135	....	....	
70,000	.00280	.00130	.00005	.00005	
73,000	.00295	.00015	....	....	Elastic limit.
74,000	.00350	.00055	....	....	
75,000	.00615	.00265	....	....	
76,000	.00780	.00165	....	....	
117,600	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	117,600
Elastic limit per square inch of original section	do	73,000
Elongation per inch after rupture	inch	.165
Elongation per inch under strain at elastic limit	do	.00295
Reduction in diameter at point of rupture	do	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		at middle of stem
Character of broken surface		silky, interspersed with fine granulation
Elongation of inch sections		".13, ".20*

BREECHBLOCK.

No. 7976.

Marks, $\frac{38587\ B_1\ F_1}{T_1\ M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00020	.00020	0.	0.	
30,000	.00115	.00095	....	....	
50,000	.00190	.00075	0.	0.	
60,000	.00220	.00030	....	....	
70,000	.00255	.00035	....	....	
75,000	.00275	.00020	....	....	
80,000	.00315	.00040	....	....	Elastic limit.
81,000	.00330	.00015	....	....	
82,000	.00360	.00030	....	....	
83,000	.00385	.00025	....	....	
84,000	.00425	.00040	....	....	
85,000	.00475	.00050	....	....	
131,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	131,500
Elastic limit per square inch of original section	do...	80,000
Elongation per inch after rupture	inch..	.145
Elongation per inch under strain at elastic limit	do...	.00315
Reduction in diameter at point of rupture	do...	.096
Reduction in area after rupture, per cent of original section		34.0
Position of rupture		".50 from neck
Character of broken surface		silky; trace of granulation
Elongation of inch sections		".20*, ".09

TABULATION OF TENSION SPECIMENS FROM 3-INCH R. F. GUNS.

STEMS 2" LONG, ".505 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
7818	Tube....	Middle..	64,000	107,500	19.0	34.0	Silky................	Breech end.
7929	....do ...	Outside.	73,000	110,600	18.0	37.1	.....do................	Do.
7959	....do ...	Middle..	69,000	106,050	21.0	46.2	.....do................	Do.
7798	Jacket ..	....do ...	66,000	112,100	19.5	43.3	.....do................	Do.
7812	....do ...	....do ...	69,000	109,500	22.0	43.3	.....do................	Do.
7969	....do ...	....do ...	73,000	105,000	24.5	49.1	Fine, silky...........	Do.
7983	....do ...	....do ...	68,000	111,000	20.0	46.2	Silky................	Do.
7960	Locking hoop.	....do ...	81,000	116,450	16.0	30.7	.....do................	Muzzle end.
7968	....do ...	....do ...	82,000	115,500	17.5	43.3	.....do................	Breech end.
7945	Breech-block.	....do ...	73,000	117,600	16.0	37.1	Silky, interspersed with fine granular.	
7976	....do ...	....do ...	80,000	131,500	14.5	34.0	Silky, trace of granulation.	

5-INCH R. F. GUNS.

SPECIMENS FROM TUBE AND JACKET.

TUBE.

No. 7811.

Marks, $\overset{54\text{-}1}{\text{M M}}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00020	.00020	0.	0.	
10,000	.00040	.00020	....	....	
20,000	.00070	.00030	....	....	
30,000	.00110	.00040	....	....	
35,000	.00125	.00015	.00005	.00005	
40,000	.00145	.00020	....	....	
42,000	.00155	.00010	.00005	0.	
50,000	.00180	.00025	....	....	
55,000	.00200	.00020	....	....	
59,000	.00220	.00020	....	....	
60,000	.00230	.00010	....	....	Elastic limit.
61,000	.00250	.00020	....	....	
62,000	.00315	.00065	....	....	
63,000	.00550	.00235	....	....	
64,000	.00800	.00250	....	....	
65,000	.00935	.00135	....	....	
99,500	....	....	....	....	Tensile strength

General summary.

Tensile strength per square inch of original section.....pounds..	99,500
Elastic limit per square inch of original section.....do...	60,000
Elongation per inch after rupture.....inch..	.255
Elongation per inch under strain at elastic limit.....do...	.00230
Reduction in diameter at point of rupture.....do...	.145
Reduction in area after rupture, per cent of original section.....	49.1
Position of rupture.....	1″.10 from neck
Character of broken surface.....	fine silky
Elongation of inch sections.....	″.33*, ″.18

JACKET.

No. 7814.

Marks, $^{60-2}_{\text{B M}}$
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000167	.000167	0.	0.	
10,000	.000367	.000200	....	....	
30,000	.001067	.000700	....	....	
40,000	.001433	.000366	....	....	
50,000	.001767	.000334	0.	0.	
60,000	.002133	.000366	....	....	
63,000	.002233	.000100	....	....	Elastic limit.
64,000	.013333	.011100	....	....	
65,000	.016667	.003334	....	....	
66,000	.020000	.003333	....	....	
96,800	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	96,800
Elastic limit per square inch of original section	do...	63,000
Elongation per inch after rupture	inch..	.223
Elongation per inch under strain at elastic limit	do...	.002233
Reduction in diameter at point of rupture	do...	.164
Reduction in area after rupture, per cent of original section		49.7
Position of rupture		1″.36 from neck
Character of broken surface		fine silky
Elongation of inch sections		″.11, ″.35*, ″.21

6-INCH R. F. GUNS.

SPECIMENS FROM TUBES, JACKETS, HOOPS, BREECH-BLOCKS, AND SPINDLE.

TUBE.

No. 7851.

Marks, $^{39455\ B_1}_{B\ T_3\ O}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00030	....	....	
30,000	.00100	.00060	....	....	
40,000	.00140	.00040	....	....	
50,000	.00175	.00035	0.	0.	
59,000	.00210	.00035	....	....	Elastic limit.
60,000	.00250	.00040	....	....	
61,000	.00825	.00575	....	....	
62,000	.00935	.00110	....	....	
98,000	....	....	....	....	Tensile strength

General summary.

Tensile strength per square inch of original section........pounds.. 98,000
Elastic limit per square inch of original section........do... 59,000
Elongation per inch after rupture........inch.. .230
Elongation per inch under strain at elastic limit........do... .00210
Reduction in diameter at point of rupture........do... .105
Reduction in area after rupture, per cent of original section........ 37.1
Position of rupture........ 1″.12 from neck
Character of broken surface........ silky
Elongation of inch sections........ ″.28*, ″.18

TUBE.

No. 7987.

Marks, $^{41349\ B_1}_{B\ T_2\ M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00080	.00055	....	....	
50,000	.00150	.00070	0.	0.	
55,000	.00175	.00025	....	....	
60,000	.00185	.00010	....	....	
64,000	.00190	.00005	....	....	Elastic limit.
65,000	.00345	.00155	....	....	
66,000	.00740	.00395	....	....	
67,000	.00805	.00065	....	....	
104,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section........pounds.. 104,500
Elastic limit per square inch of original section........do... 64,000
Elongation per inch after rupture........inch.. .230
Elongation per inch under strain at elastic limit........do... .00190
Reduction in diameter at point of rupture........do... .135
Reduction in area after rupture, per cent of original section........ 46.2
Position of rupture........ 1″.1 from neck
Character of broken surface........ silky
Elongation of inch sections........ ″.19, ″.27*

JACKET.

No. 7866.

Marks, $\overset{38953\ B_1}{B\ T_1O}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00100	.00065	....	....	
40,000	.00140	.00040	....	....	
50,000	.00185	.00045	0.	0.	
59,000	.00220	.00035	....	....	
60,000	.00230 .00700	.00010 .00470	....	....	Elastic limit.
61,000	.01100	.00400	....	....	
62,000	.01240	.00140	....	....	
63,000	.01350	.00110	....	....	
94,050	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	94,050
Elastic limit per square inch of original section	do...	60,000
Elongation per inch after rupture	inch..	.215
Elongation per inch under strain at elastic limit	do...	.00230
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		″.45 from neck
Character of broken surface		silky
Elongation of inch sections		″.12, ″.31*

JACKET.

No. 7995.

Marks, $\substack{42203\ B_3 \\ B\ T_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00080	.00055	....	....	
40,000	.00120	.00040	....	....	
50,000	.00145	.00025	0.	0.	
55,000	.00160	.00015	....	....	
60,000	.00175	.00015	....	....	
65,000	.00195	.00020	....	....	
69,000	.00215	.00020	....	....	Elastic limit.
70,000	.00245	.00030	....	....	
71,000	.00300	.00055	....	....	
72,000	.00560	.00260	....	....	
107,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	107,500
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00215
Reduction in diameter at point of rupture	do...	.145
Reduction in area after rupture, per cent of original section		49.1
Position of rupture		".9 from neck
Character of broken surface		silky
Elongation of inch sections		".12, ".30

A_1 HOOP.

No. 7999.

Marks, $\overset{41607\ B_2F_2}{M\ T_2I}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00095	.00070	....	....	
40,000	.00130	.00035	....	....	
50,000	.00155	.00025	0.	0.	
55,000	.00170	.00015	....	....	
60,000	.00180	.00010	....	....	
65,000	.00200	.00020	....	....	
70,000	.00220	.00020	....	....	
75,000	.00235	.00015	....	....	Elastic limit.
76,000	.00700	.00465	....	....	
77,000	.00950	.00250	....	....	
78,000	.01205	.00255	....	....	
104,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,500
Elastic limit per square inch of original section	do...	75,000
Elongation per inch after rupture	inch..	.060
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.025
Reduction in area after rupture, per cent of original section		9.5
Position of rupture		at the neck
Character of broken surface		silky, serrated, in part granular; dark spot ".03 by ".20
Elongation of inch sections		".05, ".07

A$_2$ HOOP.

No. 7998.

Marks, $^{42038\,B_1}_{B\,T_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00090	.00065	....	....	
40,000	.00130	.00040	....	....	
50,000	.00160	.00030	0.	0.	
55,000	.00175	.00015	....	....	
60,000	.00190	.00015	....	....	
65,000	.00205	.00015	....	....	
70,000	.00225	.00020	....	....	
74,000	.00245	.00020	....	....	Elastic limit.
75,000	.00785	.00540	....	....	
76,000	.00880	.00095	....	....	
77,000	.01050	.00170	....	....	
110,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	110,500
Elastic limit per square inch of original section	do	74,000
Elongation per inch after rupture	inch	.185
Elongation per inch under strain at elastic limit	do	.00245
Reduction in diameter at point of rupture	do	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		″.9 from neck
Character of broken surface		silky
Elongation of inch sections		″.10, ″.27*

A_2 Hoop.

No. 8003.

Marks, $\overset{41753\ B,}{B\ T_2\ M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00090	.00065	....	....	
40,000	.00120	.00030	....	....	
50,000	.00150	.00030	0.	0.	
55,000	.00170	.00020	....	....	
60,000	.00185	.00015	....	....	
65,000	.00205	.00020	....	....	
70,000	.00220	.00015	....	....	
75,000	.00240	.00020	....	....	Elastic limit.
76,000	.01260	.01020	....	....	
77,000	.01370	.00110	....	....	
78,000	.01480	.00110	....	....	
110,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	110,500
Elastic limit per square inch of original section	do...	75,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00240
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		″.7 from neck
Character of broken surface		silky
Elongation of inch sections		″.12, ″.28*

C_1 HOOP.

No. 8000.

Marks, $\genfrac{}{}{0pt}{}{41543\ B_2\ F_1}{BT_2\ M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00090	.00065	....	....	
40,000	.00120	.00030	....	....	
50,000	.00155	.00035	0.	0.	
55,000	.00165	.00010	....	....	
60,000	.00190	.00025	....	....	
65,000	.00205	.00015	....	....	
70,000	.00225	.00020	....	....	
72,000	.00235	.00010	....	....	Elastic limit.
73,000	.01150	.00915	....	....	
74,000	.01240	.00090	....	....	
75,000	.01360	.00120	....	....	
105,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	105,500
Elastic limit per square inch of original section	do	72,000
Elongation per inch after rupture	inch	.190
Elongation per inch under strain at elastic limit	do	.00235
Reduction in diameter at point of rupture	do	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		″.90 from neck
Character of broken surface		silky
Elongation of inch sections		″.11, ″.27*

C$_2$ Hoop.

No. 7977.

Marks, $\substack{41224\ B_2\ F_2 \\ B\ T_2\ M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	....	....	
30,000	.00100	.00070	....	....	
40,000	.00140	.00040	....	....	
50,000	.00170	.00030	0.	0.	
60,000	.00210	.00040	....	....	
70,000	.00245	.00035	....	....	
74,000	.00265	.00020	....	....	Elastic limit.
75,000	.00280	.00015	....	....	
76,000	.00315	.00035	....	....	
77,000	.00725	.00410	....	....	
78,000	.01060	.00335	....	....	
105,000	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	105,000
Elastic limit per square inch of original section	do...	74,000
Elongation per inch after rupture	inch..	.220
Elongation per inch under strain at elastic limit	do...	.00265
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		1″ from neck
Character of broken surface		silky
Elongation of inch sections		″.14, ″.30*

D Hoop.

No. 7997.

Marks, $\overset{41634\ B_3}{B\ T_3\ I}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	.0	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00085	.00060	....	....	
40,000	.00120	.00035	....	....	
50,000	.00150	.00030	0.	0.	
55,000	.00165	.00015	....	....	
60,000	.00185	.00020	....	....	
65,000	.00200	.00015	....	....	
70,000	.00220	.00020	....	....	
74,000	.00235	.00015	....	....	Elastic limit.
75,000	.01710	.01475	....	....	
76,000	.01750	.00040	....	....	
77,000	.01830	.00080	....	....	
104,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,500
Elastic limit per square inch of original section	do...	74,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		″.85 from neck
Character of broken surface		silky
Elongation of inch sections		″.30*, ″.12

BREECHBLOCK.

No. 7908.

Marks, $^{40427\ B_6}_{T.M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
30,000	.00095	.00085	....	....	
50,000	.00160	.00065	0.	0.	
70,000	.00235	.00075	....	....	
73,000	.00255	.00020	....	....	
74,000	.00265	.00010	....	....	Elastic limit.
75,000	.00300	.00035	....	....	
76,000	.00465	.00165	....	....	
77,000	.00505	.00040	....	....	
78,000	.00575	.00070	....	....	
127,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	127,500
Elastic limit per square inch of original section	do...	74,000
Elongation per inch after rupture	inch..	.155
Elongation per inch under strain at elastic limit	do...	.00265
Reduction in diameter at point of rupture	do...	.075
Reduction in area after rupture, per cent of original section		27.4
Position of rupture		″.75 from neck
Character of broken surface		fine granular
Elongation of inch sections		″.21*, ″.10

BREECHBLOCK.

No. 7953.

Marks, $^{41240\ B_3}_{T_1M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
30,000	.00110	.00095	....	....	
50,000	.00180	.00070	0.	0.	
60,000	.00215	.00035	....	....	
70,000	.00250	.00035	....	....	
80,000	.00290	.00040	....	....	
85,000	.00310	.00020	....	....	Elastic limit.
86,000	.01720	.01410	....	....	
87,000	.01775	.00055	....	....	
88,000	.01870	.00095	....	....	
121,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	121,500
Elastic limit per square inch of original section	do...	85,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00310
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		″.9 from neck
Character of broken surface		silky
Elongation of inch sections		″.25*, ″.12

BREECHBLOCK.

No. 7978.

Marks, $^{41124\ B_6}_{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
30,000	.00095	.00085	....	....	
50,000	.00165	.00070	0.	0.	
55,000	.00180	.00015	....	....	
60,000	.00200	.00020	....	....	
65,000	.00215	.00015	....	....	
70,000	.00235	.00020	....	....	
75,000	.00255	.00020	....	....	
80,000	.00270	.00015	....	....	
83,000	.00280	.00010	....	....	Elastic limit.
84,000	.01030	.00750	....	....	
85,000	.01080	.00050	....	....	
86,000	.01160	.00080	....	....	
130,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	130,500
Elastic limit per square inch of original section	do	83,000
Elongation per inch after rupture	inch	.165
Elongation per inch under strain at elastic limit	do	.00280
Reduction in diameter at point of rupture	do	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		".85 from neck
Character of broken surface		silky
Elongation of inch sections		".10, ".23*

BREECHBLOCK.

No. 7979.

Marks, $^{41125\ B_6}_{T_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	....	....	
30,000	.00080	.00070	....	....	
50,000	.00150	.00070	0.	0.	
55,000	.00170	.00020	....	....	
60,000	.00185	.00015	....	....	
65,000	.00205	.00020	....	....	
70,000	.00220	.00015	....	....	
75,000	.00240	.00020	....	....	
80,000	.00275	.00035	....	....	Elastic limit.
81,000	.00350	.00075	....	....	
82,000	.00805	.00055	....	....	
83,000	.00880	.00075	....	....	
127,000	....	....	....	....	Tensile strength.

General summary

Tensile strength per square inch of original section	pounds..	127,000
Elastic limit per square inch of original section	do...	80,000
Elongation per inch after rupture	inch..	.115
Elongation per inch under strain at elastic limit	do...	.00275
Reduction in diameter at point of rupture	do...	.055
Reduction in area after rupture, per cent of original section		20.5
Position of rupture		1″.08 from neck
Character of broken surface		granular, 60 per cent; silky, 40 per cent
Elongation of inch sections		″.13*, ″.10

BREECHBLOCK.

No. 7988.

Marks, $^{41240\ B_6}_{T,M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00090	.00065	....	....	
50,000	.00160	.00070	0.	0.	
55,000	.00175	.00015	....	....	
60,000	.00190	.00015	....	....	
65,000	.00210	.00020	....	....	
70,000	.00235	.00025	....	....	
75,000	.00255	.00020	....	....	
80,000	.00275	.00020	....	....	
84,000	.00290	.00015	....	....	Elastic limit.
85,000	.01330	.01040	....	....	
86,000	.01410	.00080	....	....	
87,000	.01500	.00090	....	....	
122,000	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section....pounds..	122,000
Elastic limit per square inch of original section....do...	84,000
Elongation per inch after rupture....inch..	.155
Elongation per inch under strain at elastic limit....do...	.00290
Reduction in diameter at point of rupture....do...	.065
Reduction in area after rupture, per cent of original section....	23.9
Position of rupture....	".85 from neck
Character of broken surface....	silky, oblique
Elongation of inch sections....	".20*, ".11

SPINDLE.

No. 7994.

Marks, $^{14637\,B_1F_1}_{L}$

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
30,000	.00085	.00075	....	....	
50,000	.00150	.00065	0.	0.	
55,000	.00170	.00020	....	....	
60,000	.00185	.00015	....	....	
65,000	.00200	.00015	....	....	
70,000	.00220	.00020	....	....	
75,000	.00235	.00015	....	....	
80,000	.00255	.00020	....	....	
85,000	.00275	.00020	....	....	
86,000	.00285	.00010	....	....	Elastic limit.
87,000	.00300	.00015	....	....	
88,000	.00330	.00030	....	....	
89,000	.00385	.00055	....	....	
90,000	.00555	.00170	....	....	
114,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,500
Elastic limit per square inch of original section	do...	86,000
Elongation per inch after rupture	inch..	.225
Elongation per inch under strain at elastic limit	do...	.00285
Reduction in diameter at point of rupture	do...	.185
Reduction in area after rupture, per cent of original section		59.8
Position of rupture		".95 from neck
Character of broken surface		fine silky, serrated
Elongations of inch sections		".10, ".35*

TABULATION OF TENSION SPECIMENS FROM 6-INCH R. F. GUNS.

STEMS 2" LONG, ".505 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds	*Pounds.*	*Per ct.*	*Per ct.*		
7851	Tube.........	Outside.	59,000	98,000	23.0	37.1	Silky............	Breech end.
7987	.....do........	Middle..	64,000	104,500	23.0	46.2	.....do...........	Do.
7866	Jacket........	Outside.	60,000	94,050	21.5	46.2	.....do...........	Do.
7995	.....do........	Middle..	69,000	107,500	21.0	49.1	.....do...........	Do.
7999	A_1 hoop......	Inside...	75,000	104,500	6.0	9.5	Silky, serrated; in part granular; dark spot.	Muzzle end.
7998	A_2 hoop......	Middle..	74,000	110,500	18.5	43.3	Silky............	Breech end.
8003	.....do........	....do...	75,000	110,500	20.0	40.3	.....do...........	Do.
8000	C_1 hoop......	....do...	72,000	105,500	19.0	40.3	.....do...........	Do.
7977	C_2 hoop......	....do...	74,000	105,000	22.0	40.3	.....do...........	Do.
7997	D hoop......	Inside...	74,000	104,500	21.0	46.2	.....do...........	Do.
7908	Breechblock..	Middle..	74,000	127,500	15.5	27.4	Fine granular....	
7953	.....do........	....do...	85,000	121,500	18.5	37.1	Silky............	
7978	.....do........	....do...	83,000	130,500	16.5	40.3	.....do...........	
7979	.....do........	....do...	80,000	127,000	11.5	20.5	Granular, 60 per cent; silky, 40 per cent.	
7988	.....do........	....do...	84,000	122,000	15.5	23.9	Silky, oblique....	
7994	Spindle......	....	86,000	114,500	22.5	59.8	Fine silky, serrated.	

Nickel steel from tubes of 6-inch R. F. guns.

TUBE.

No. 7909.

Marks, $^{6\ R\ F_{12}T}_{B\ T_{3}M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025			
30,000	.00110	.00075			
40,000	.00150	.00040			
50,000	.00200	.00050	.00005	.00005	
54,000	.00230	.00030			Elastic limit.
55,000	.00250	.00020			
56,000	.00385	.00135			
57,000	.00665	.00280			
58,000	.00815	.00150			
90,500					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	90,500
Elastic limit per square inch of original section	do	54,000
Elongation per inch after rupture	inch	.230
Elongation per inch under strain at elastic limit	do	.00230
Reduction in diameter at point of rupture	do	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		1″.35 from neck
Character of broken surface		silky
Elongation of inch sections		″.18, ″.28*

TUBE.

No. 7910.

Marks, $^{6\ R\ F_{12}T}_{B\ T_{4}M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020			
30,000	.00110	.00075			
40,000	.00155	.00045			
50,000	.00195	.00040	0.	0.	
57,000	.00235	.00040			Elastic limit.
58,000	.00260	.00025			
59,000	.00610	.00350			
60,000	.00805	.00195			
91,500					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds	91,500
Elastic limit per square inch of original section	do	57,000
Elongation per inch after rupture	inch	.225
Elongation per inch under strain at elastic limit	do	.00235
Reduction in diameter at point of rupture	do	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		″.75 from neck
Character of broken surface		silky
Elongation of inch sections		″.32*, ″.13

TUBE.

No. 7911.

Marks, $\begin{matrix}6\,R\,F_{12}T\\ M\,T_{3}M\end{matrix}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00105	.00080	....	....	
40,000	.00150	.00045	....	....	
50,000	.00185	.00035	0.	0.	
54,000	.00205	.00020	....	....	Elastic limit.
55,000	.00460	.00255	....	....	
56,000	.01160	.00700	....	....	
57,000	.01300	.00140	....	....	
89,000	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds.. 89,000
Elastic limit per square inch of original section..........do... 54,000
Elongation per inch after rupture..........inch.. .215
Elongation per inch under strain at elastic limit..........do... .00205
Reduction in diameter at point of rupture..........do... .095
Reduction in area after rupture, per cent of original section.......... 34.0
Position of rupture.......... ″.75 from neck
Character of broken surface.......... fibrous, trace of granulation
Elongation of inch sections.......... ″.15, ″.28*

TUBE.

No. 7912.

Marks, $\begin{matrix}6\,R\,F_{12}T\\ M\,T_{4}M\end{matrix}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00040	.00025	....	....	
30,000	.00115	.00075	....	....	
40,000	.00160	.00045	....	....	
50,000	.00200	.00040	.00005	.00005	
54,000	.00230	.00030	....	....	Elastic limit.
55,000	.00300	.00070	....	....	
56,000	.00550	.00250	....	....	
57,000	.01075	.00525	....	....	
58,000	.01220	.00145	....	....	
89,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds.. 89,500
Elastic limit per square inch of original section..........do... 54,000
Elongation per inch after rupture..........inch.. .190
Elongation per inch under strain at elastic limit..........do... .00230
Reducion in diameter at point of rupture..........do... .065
Reduction in area after rupture, per cent of original section.......... 23.9
Position of rupture.......... ″.90 from the neck
Character of broken surface.......... granular, 80 per cent; lamellar, 20 per cent
Elongation of inch sections.......... ″.15, ″.23*

TUBE.

No. 7913.

Marks, $^{6\,R\,F_{14}T}_{B\,T_{4}M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00105	.00070	....	....	
40,000	.00150	.00045	....	....	
50,000	.00190	.00040	0.	0.	
61,000	.00250	.00060	....	....	Elastic limit.
62,000	.00345	.00095	....	....	
63,000	.00620	.00275	....	....	
64,000	.00750	.00130	....	....	
96,400	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	96,400
Elastic limit per square inch of original section	do...	61,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		".90 from neck
Character of broken surface		silky
Elongation of inch sections		".29*, ".13

TUBE.

No. 7914.

Marks, $^{6\,R\,F_{14}T}_{B\,T_{5}M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00005	.00005	0.	0.	
10,000	.00025	.00020	....	....	
30,000	.00090	.00065	....	....	
40,000	.00120	.00030	....	....	
50,000	.00160	.00040	0.	0.	
58,000	.00220	.00060	....	....	Elastic limit.
59,000	.00320	.00100	....	....	
60,000	.00500	.00180	....	....	
61,000	.00830	.00330	....	....	
92,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	92,500
Elastic limit per square inch of original section	do...	58,000
Elongation per inch after rupture	inch..	.230
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		1" from neck
Character of broken surface		silky
Elongation of inch sections		".14, ".32*

TUBE.

No. 7915.

Marks, $^{6\,R\,F_{14}T}_{M\,T_4M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015			
30,000	.00110	.00080			
40,000	.00150	.00040			
50,000	.00190	.00040	0.	0.	
65,000	.00250	.00060			Elastic limit.
66,000	.01025	.00775			
67,000	.01175	.00150			
68,000	.01250	.00075			
97,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	97,000
Elastic limit per square inch of original section	do...	65,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		1″.25 from neck
Character of broken surface		fibrous, trace of granulation
Elongation of inch sections		″.18, ″.24*

TUBE.

No. 7916.

Marks, $^{6\,R\,F_{14}T}_{M\,T_5M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025			
30,000	.00105	.00070			
40,000	.00150	.00045			
50,000	.00185	.00035	0.	0.	
62,000	.00235	.00050			Elastic limit.
63,000	.00515	.00280			
64,000	.00900	.00385			
65,000	.01100	.00200			
95,500					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	95,500
Elastic limit per square inch of original section	do...	62,000
Elongation per inch after rupture	inch..	.205
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		″.50 from neck
Character of broken surface		fine, granular, 60 per cent; lamellar, 40 per cent
Elongation of inch sections		″.13, ″.28*

TUBE.

No. 7930.

Marks, $\substack{39680\ B_2 \\ M\ T_3M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00100	.00065	....	....	
40,000	.00140	.00040	....	....	
50,000	.00175	.00035	0.	0.	
60,000	.00210	.00035	....	....	
63,000	.00230	.00020	....	....	Elastic limit.
64,000	.00300	.00070	....	....	
65,000	.01200	.00900	....	....	
66,000	.01375	.00175	....	....	
95,100	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section........pounds..	95,100
Elastic limit per square inch of original section........do...	63,000
Elongation per inch after rupture........inch..	.185
Elongation per inch under strain at elastic limit........do...	.00230
Reduction in diameter at point of rupture........do...	.095
Reduction in area after rupture, per cent of original section........	34.0
Position of rupture........	″.6 from neck
Character of broken surface........	silky, oblique
Elongation of inch sections........	″.25*, ″.12

TUBE.

No. 7931.

Marks, $\substack{39680\ B_2 \\ M\ T_4I}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	....	....	
30,000	.00095	.00065	....	....	
40,000	.00130	.00035	....	....	
50,000	.00160	.00030	0.	0.	
60,000	.00200	.00040	....	....	
62,000	.00215	.00015	....	....	
63,000	.00220	.00005	....	....	Elastic limit.
64,000	.00850	.00630	....	....	
65,000	.01000	.00150	....	....	
66,000	.01150	.00150	....	....	
96,500	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section........pounds..	96,500
Elastic limit per square inch of original section........do...	63,000
Elongation per inch after rupture........inch..	.160
Elongation per inch under strain at elastic limit........do...	.00220
Reduction in diameter at point of rupture........do...	.075
Reduction in area after rupture, per cent of original section........	27.4
Position of rupture........	″.60 from neck
Character of broken surface........	silky, lamellar
Elongation of inch sections........	″.20*, ″.12

TUBE.

No. 7932.

Marks, $\overset{39680\ B_2}{B\ T_3O}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	....	....	
30,000	.00095	.00065	....	....	
40,000	.00125	.00030	....	....	
50,000	.00160	.00035	0.	0.	
60,000	.00195	.00035	....	....	
64,000	.00210	.00015	....	....	Elastic limit.
65,000	.01075	.00865	....	....	
66,000	.01200	.00125	....	....	
67,000	.01290	.00090	....	....	
96,300	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds..	96,300
Elastic limit per square inch of original section..........do...	64,000
Elongation per inch after rupture..........inch..	.220
Elongation per inch under strain at elastic limit..........do...	.00210
Reduction in diameter at point of rupture..........do...	.125
Reduction in area after rupture, per cent of original section..........	43.3
Position of rupture..........	at middle of stem
Character of broken surface..........	silky
Elongation of inch sections..........	″.24*, ″.20*

TUBE.

No. 7933.

Marks, $\overset{39680\ B_2}{B\ T_4M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	....	....	
30,000	.00095	.00060	....	....	
40,000	.00130	.00035	....	....	
50,000	.00160	.00030	0.	0.	
60,000	.00200	.00040	....	....	
64,000	.00220	.00020	....	....	Elastic limit.
65,000	.01150	.00930	....	....	
66,000	.01300	.00150	....	....	
67,000	.01400	.00100	....	....	
97,000	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds..	97,000
Elastic limit per square inch of original section..........do...	64,000
Elongation per inch after rupture..........inch..	.200
Elongation per inch under strain at elastic limit..........do...	.00220
Reduction in diameter at point of rupture..........do...	.105
Reduction in area after rupture, per cent of original section..........	37.1
Position of rupture..........	″.45 from neck
Character of broken surface..........	silky
Elongation of inch sections..........	″.27*, ″.13

TUBE.

No. 7954.

Marks, $\begin{matrix}39746\ B_3\\ B\ T_3O\end{matrix}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	....	....	
30.000	.00110	.00075	....	....	
40,000	.00140	.00030	....	....	
50,000	.00175	.00035	0.	0.	
60,000	.00205	.00030	....	....	
63,000	.00225	.00020	....	....	Elastic limit.
64,000	.00295	.00070	....	....	
65,000	.00965	.00670	....	....	
66,000	.01010	.00045	....	....	
98,250	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds.. 98,250
Elastic limit per square inch of original section..........do... 63,000
Elongation per inch after rupture..........inch.. .140
Elongation per inch under strain at elastic limit..........do... .00225
Reduction in diameter at point of rupture..........do... .045
Reduction in area after rupture, per cent of original section.......... 16.9
Position of rupture.......... 1″.03 from neck
Character of broken surface.......... granular, 50 per cent; serrated, flaky, 50 per cent
Elongation of inch sections.......... ″.16*, ″.12

TUBE.

No. 7955.

Marks, $\begin{matrix}39746\ B_3\\ B\ T_4M\end{matrix}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	....	....	
30,000	.00095	.00070	....	....	
40,000	.00125	.00030	....	....	
50,000	.00160	.00035	0.	0.	
59,000	.00195	.00035	....	....	Elastic limit.
60,000	.00220	.00025	....	....	
61,000	.00925	.00705	....	....	
62,000	.01005	.00080	....	....	
95,650	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds.. 95,650
Elastic limit per square inch of original section..........do... 59,000
Elongation per inch after rupture..........inch.. .205
Elongation per inch under strain at elastic limit..........do... .00195
Reduction in diameter at point of rupture..........do... .115
Reduction in area after rupture, per cent of original section.......... 40.3
Position of rupture.......... at middle of stem
Character of broken surface.......... silky
Elongation of inch sections.......... ″.20*, ″.21*

TUBE.

No. 7956.

Marks, $\genfrac{}{}{0pt}{}{39746\ B_3}{M\ T_3M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	....	....	
30,000	.00115	.00080	....	....	
40,000	.00155	.00040	....	....	
50,000	.00195	.00040	.00005	.00005	
59,000	.00230	.00035	....	....	Elastic limit.
60,000	.01405	.01175	....	....	
61,000	.01465	.00060	....	....	
62,000	.01575	.00110	....	....	
86,800	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds.. 86,800
Elastic limit per square inch of original section..........do... 59,000
Elongation per inch after rupture..........inch.. .105
Elongation per inch under strain at elastic limit..........do... .00230
Reduction in diameter at point of rupture..........do... .065
Reduction in area after rupture, per cent of original section.......... 23.9
Position of rupture.......... at middle of stem
Character of broken surface.......... gray, serrated, flaky; tore apart in detail from one side
Elongation of inch sections.......... ".08, ".13*

TUBE.

No. 7957.

Marks, $\genfrac{}{}{0pt}{}{39746\ B_3}{M\ T_4I}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00030	....	....	
30,000	.00100	.00060	....	....	
40,000	.00130	.00030	....	....	
50,000	.00170	.00040	0.	0.	
52,000	.00185	.00015	....	....	Elastic limit.
53,000	.00350	.00165	....	....	
54,000	.00440	.00090	....	....	
55,000	.00515	.00075	....	....	Crack opens in stem.
56,000	.00640	.00125	....	....	
60,100	....	....	....	....	Tensile strength.

General summary.

Tensile strength per square inch of original section..........pounds.. 60,100
Elastic limit per square inch of original section..........do... 52,000
Elongation per inch after rupture..........inch.. .045
Elongation per inch under strain at elastic limit..........do... .00185
Reduction in diameter at point of rupture..........do... .055
Reduction in area after rupture, per cent of original section.......... 20.5
Position of rupture.......... ".65 from neck
Character of broken surface.......... granular, 10 per cent; serrated, flaky, 90 per cent; fractured in detail by the extension of the crack which appeared under 55,000 pounds per square inch tension
Elongation of inch sections.......... ".01, ".08*

TABULATION OF TENSION SPECIMENS FROM NICKEL-STEEL TUBES OF 6" R. F. GUNS.

STEMS 2" LONG, ".505 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Lbs.	*Lbs.*	*Per ct.*	*Per ct.*		
7909	Tube....	Middle..	54,000	90,500	23.0	40.3	Silky................	Breech end.
7910	....do....	....do ...	57,000	91,500	22.5	43.3	.....do..............	Do.
7911	....do....	....do ...	54,000	89,000	21.5	34.0	Fibrous, trace of granulation.	Muzzle end.
7912	....do....	....do ...	54,000	89,500	19.0	23.9	Granular, 80 per cent; lamellar, 20 per cent.	Do.
7913	....do....	....do ...	61,000	96,400	21.0	43.3	Silky................	Breech end.
7914	....do....	....do ...	58,000	92,500	23.0	46.2	.....do..............	Do.
7915	....do....	....do ...	65,000	97,000	21.0	37.1	Fibrous, trace of granulation.	Muzzle end.
7916	....do....	....do ...	62,000	95,500	20.5	37.1	Fine granular, 60 per cent; lamellar, 40 per cent.	Do.
7930	....do....	....do ...	63,000	95,100	18.5	34.0	Silky, oblique........	Do.
7931	....do....	Inside...	63,000	96,500	16.0	27.4	Silky, lamellar.......	Do.
7932	....do....	Outside.	64,000	96,300	22.0	43.3	Silky................	Breech end.
7933	....do....	Middle..	64,000	97,000	20.0	37.1	.....do..............	Do.
7954	....do....	Outside.	63,000	98,250	14.0	16.9	Granular, 50 per cent; serrated, flaky, 50 per cent.	Do.
7955	....do....	Middle..	59,000	95,650	20.5	40.3	Silky................	Do.
7956	....do....	....do ...	59,000	86,890	10.5	23.9	Gray, serrated, flaky.	Muzzle end.
7957	....do....	Inside..	52,000	60,100	4.5	20.5	Granular, 10 per cent; serrated, flaky, 90 per cent.	Do.

STEEL FORGINGS, GUN AND CARRIAGE WORK.

75-MILLIMETER MOUNTAIN GUNS.

BODIES.

SPECIMENS FROM BREECH ENDS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds*	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″	
2A	.505	.20	60,200	100,500	21.0	43.3	.31*, .11	Silky.
3X*	.505	.20	62,500	105,500	21.0	40.3	.29*, .13	Do.
2B*-B	.564	.25	57,600	100,400	17.7	39.2	.31*, .12, .10	Do.
2A*-B	.564	.25	59,600	99,200	20.3	41.9	.13, .16, .32*	Do.
4A**-B	.564	.25	54,800	95,920	17.7	41.9	.11, .11, .31*	Do.
5**-B	.564	.25	56,800	104,000	16.3	36.4	.28*, .10, .11	Do.
4B*-B	.564	.25	54,800	94,400	19.3	44.6	.34*, .13, .11	Do.
17-BT$_1$M	.505	.20	64,500	107,000	20.0	37.1	.14, .26*	Do.
17-BT$_2$M	.505	.20	65,500	107,500	19.5	40.3	.11, .28*	Do.
20-BT$_1$M	.505	.20	66,000	111,250	18.5	37.1	.11, .26*	Do.
20-BT$_2$M	.505	.20	63,500	109,000	20.0	37.1	.27*, .13	Do.
22-BT$_1$M	.505	.20	53,000	92,000	25.0	46.2	.20, .30*	Do.
22-BT$_2$M	.505	.20	61,000	102,200	19.0	37.1	.28*, .10	Do.
24-BT$_1$M	.505	.20	61,500	100,100	20.0	37.1	.12, .28*	Do.
24-BT$_2$M	.505	.20	62,000	99,900	23.0	43.3	.15, .31*	Do.
16-BT$_1$M	.505	.20	63,000	102,500	19.5	40.3	.14, .25*	Do.
16-BT$_2$M	.505	.20	61,500	102,500	19.5	40.3	.28*, .11	Do.
18-BT$_1$M	.505	.20	60,000	97,800	24.5	46.2	.32*, .17	Do.
18-BT$_2$M	.505	.20	61,500	97,500	20.5	43.3	.22*, .19	Do.
26-BT$_1$M	.505	.20	60,000	96,500	23.0	49.1	.35*, .11	Do.
28-BT$_1$M	.505	.20	61,000	102,500	20.5	40.3	.22*, .19	Do.
29-BT$_1$M	.505	.20	54,500	96,000	20.0	43.3	.30*, .10	Do.
30-BT$_1$M	.505	.20	61,500	97,250	20.5	40.3	.23*, .18	Do.
33-BT$_1$M	.505	.20	62,500	102,000	20.0	43.3	.11, .29*	Do.
32-BT$_1$M	.505	.20	62,500	100,500	22.0	40.3	.12, .32*	Do.
35-BT$_1$M	.505	.20	64,000	104,500	19.5	40.3	.11, .28*	Do.
36-BT$_1$M	.505	.20	62,000	105,500	15.0	30.7	.22*, .08	Granular, 60 per cent; silky, 40 per cent.
19-BT$_1$M	.505	.20	63,000	105,000	21.5	40.3	.30*, .13	Silky.
21-BT$_1$M	.505	.20	63,500	101,500	22.0	46.2	.12, .32*	Do.
23-BT$_1$M	.505	.20	62,000	101,900	20.5	37.1	.20*, .21*	Do.
25-BT$_1$M	.505	.20	61,000	105,500	20.0	34.0	.28*, .12	Do.
27-BT$_1$M	.505	.20	62,500	104,500	20.5	40.3	.28*, .13	Do.
31-BT$_1$M	.505	.20	64,000	106,000	20.5	37.1	.14, .27*	Do.
34-BT$_1$M	.505	.20	66,000	111,500	18.0	30.7	.11, .25*	Do.
2BT-BT$_3$M	.505	.20	59,500	102,000	25.0	37.1	.21, .29*	Do.
36-BT$_2$M	.505.	.20	57,000	104,500	17.0	34.0	.23*, .11	Silky and granular.
25-BT$_2$M	.505	.20	56,000	102,500	21.0	37.1	.24*, .18	Silky.
34-BT$_2$M	.505	.20	62,500	110,900	15.0	34.0	.10, .20*	Silky, 60 per cent; granular 40 per cent.
4A-BT$_4$M	.505	.20	57,700	98,900	20.5	40.3	.11, .30*	Silky.
5T-BT$_4$M	.505	.20	60,300	105,000	19.5	37.1	.26*, .13	Do.
4BT-BT$_3$M	.505	.20	60,300	102,000	23.5	43.3	.15, .32*	Do.
13-BT$_1$M	505	.20	65,500	112,300	18.0	34.0	.25*, .11	Do.
13-BT$_1$M	505	.20	58,500	102,500	21.0	37.1	.13, .29*	Do.

75-MILLIMETER MOUNTAIN GUNS—Continued.

BODIES—Continued.

SPECIMENS FROM MUZZLE ENDS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds*	*Pounds.*	*Per ct.*	*Per ct.*	* * *	
9	.505	.20	57,000	99,500	21.0	40.3	.30*, .12	Silky.
9A	.505	.20	62,500	101,000	23.5	43.3	.27*, .20	Do.
M1-4B	.505	.20	48,500	86,000	25.5	40.3	.16, .35*	Do.
M1-2A	.505	.20	59,500	92,500	22.0	40.3	.29*, .15	Do.
M2-2B	.505	.20	58,000	96,800	20.5	43.3	.29*, .11	Do.
M2-4A	.505	.20	51,500	88,000	25.5	43.3	.18, .33*	Do.
M1-2B	.505	.20	54,500	95,100	21.5	40.3	.12, .31*	Do.
M2-2A	.505	.20	55,500	91,500	22.5	43.3	.32*, .13	Do.
M2-4B	.505	.20	50,750	87,000	20.0	43.3	.32*, .08	Do.
M1-4A	.505	.20	54,500	87,500	24.5	46.2	.14, .35*	Do.
M2-5	.505	.20	62,000	96,500	20.0	40.3	.21*, .19*	Do.
M1-5	.505	.20	60,500	97,000	20.5	43.3	.14, .27*	Do.
17-MT$_1$M	.505	.20	68,000	108,500	20.0	37.1	.13, .27*	Do.
17-MT$_2$M	.505	.20	68,500	109,200	21.0	37.1	.14, .28*	Do.
20-MT$_1$M	.505	.20	66,000	105,500	19.0	37.1	.12, .26*	Do.
20-MT$_2$M	.505	.20	66,500	105,000	19.0	37.1	.28*, .10	Do.
22-MT$_1$M	.505	.20	56,000	97,500	17.0	40.3	.27*, .07	Do.
22-MT$_2$M	.505	.20	49,500	93,600	16.0	37.1	.25*, .08	Do.
24-MT$_1$M	.505	.20	64,500	100,300	22.0	40.3	.30, .14	Do.
24-MT$_2$M	.505	.20	64,500	100,000	22.5	40.3	.31*, .14	Do.
16-MT$_1$M	.505	.20	62,000	102,000	20.5	37.1	.11, .30*	Do.
16-MT$_2$M	.505	.20	64,000	100,500	19.5	40.3	.11, .28*	Do.
18-MT$_1$M	.505	.20	58,000	96,500	21.5	43.3	.32*, .11	Do.
18-MT$_2$M	.505	.20	60,000	97,000	21.5	43.3	.31*, .12	Do.
22-MT$_3$M	.505	.20	86,000	96,250	18.5	40.3	.27*, .09	Do.
22-MT$_4$M	.505	.20	56,500	97,000	18.5	43.3	.10, .27*	Silky and granular.
26-MT$_1$M	.505	.20	62,000	98,500	24.0	40.3	.29*, .19	Silky.
28-MT$_1$M	.505	.20	65,500	102,500	19.5	40.3	.09, .30*	Do.
29-MT$_2$M	.505	.20	63,000	107,000	22.5	40.3	.30*, .15	Do.
30-MT$_1$M	.505	.20	49,500	92,800	18.5	37.1	.27*, .10	Do.
33-MT$_1$M	.505	.20	62,500	105,500	17.5	37.1	.26*, .09	Do.
30-MT$_2$M	.505	.20	60,500	98,000	19.0	37.1	.11, .27*	Do.
33-MT$_2$M	.505	.20	64,500	104,500	19.0	40.3	.11, .27*	Do.
32-MT$_1$M	.505	.20	64,500	108,000	20.0	40.3	.28*, .12	Do.
35-MT$_1$M	.505	.20	64,500	107,500	19.5	37.1	.14, .25*	Do.
36-MT$_1$M	.505	.20	70,000	114,000	19.5	37.1	.24*, .15	Do.
19-MT$_1$M	.505	.20	58,500	98,900	21.0	40.3	.13, .29*	Do.
21-MT$_1$M	.505	.20	63,500	100,500	22.5	43.3	.18, .27*	Do.
23-MT$_1$M	.505	.20	54,500	93,700	24.5	40.3	.32*, .17	Do.
25-MT$_1$M	.505	.20	66,000	109,500	19.0	37.1	.12, .26*	Do.
27-MT$_1$M	.505	.20	63,500	106,000	20.0	37.1	.12, .28*	Do.
31-MT$_1$M	.505	.20	63,500	104,000	18.0	34.0	.10, .25*	Do.
34-MT$_1$M	.505	.20	68,500	110,500	19.0	34.0	.25*, .13	Do.
31-MT$_2$M	.505	.20	68,000	105,300	18.5	37.1	.11, .26*	Silky; trace of granulation.
34-MT$_2$M	.505	.20	71,500	111,800	18.0	34.0	.11, .25*	Do.
13-MT$_1$M	.505	.20	68,500	110,350	16.0	30.7	.22*, .10	Do.
13-MT$_1$M	.505	.20	65,500	102,000	19.0	40.3	.27*, .11	Silky.

BLOCK CARRIERS.

C-1	.564	.25	69,600	116,800	16.0	39.2	.09, .11, .28*	Silky; trace of granulation.
BC-24	.505	.20	56,000	98,000	20.5	51.9	.34*, .07	Fine silky.
BC-26	.505	.20	60,500	100,500	24.5	59.8	.38*, .11	Do.
BC-12	.505	.20	59,500	99,500	25.5	49.1	.37*, .14	Silky.

3-INCH R. F. GUNS.

BLOCK CARRIERS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds*	*Pounds.*	*Per ct.*	*Per ct.*	″ ″	
$3R_1BCL$	.505	.20	54,500	103,500	22.5	34.0	.31*, .14	Silky; trace of granulation.
3R-BC25	.505	.20	51,000	96,000	22.5	40.3	.22*, .21*	Silky.
3R-BC8	.505	.20	48,000	96,500	21.5	37.1	.16, .27*	Do.
3R-BC36	.505	.20	54,500	95,800	24.5	40.3	.20*, .29*	Do.
3R-BC44	.505	.20	44,500	95,500	20.5	30.7	.27*, .14	Do.
3R-BC44	.505	.20	53,500	94,500	22.5	34.0	.30*, .15	Do.
36BC	.505	.20	44,000	83,000	14.0	23.9	.11, .17*	Dull silky.
54BC	.505	.20	48,000	83,500	15.0	20.5	.13, .17*	Do.
55BC	.505	.20	46,000	80,000	10.0	13.2	.09, .11*	Dull gray; oblique.
72BC	.505	.20	44,500	85,000	17.0	34.0	.09, .25*	Silky.

CLIPS.

CLTo1	.505	.20	46,500	99,500	18.5	30.7	.16, .21*	Silky, 50 per cent; granular, 50 per cent.
CLTo2	.505	.20	43,000	93,500	19.5	30.7	.20*, .19*	Silky; trace of granulation.
CLTo3	.505	.20	43,000	94,500	19.5	30.7	.21*, .18*	Granular, 60 per cent; silky, 40 per cent.
CLTo4	.505	.20	44,000	97,600	17.5	27.4	.13, .22*	Granular, 70 per cent; silky, 30 per cent.
1FG	.505	.20	54,500	96,500	23.0	40.3	.13, .33*	Silky.
11FG	.505	.20	50,000	96,000	22.0	37.1	.30*, 14	Do.
12FG	.505	.20	50,500	95,000	21.5	37.1	.12, .31*	Do.
22FG	.505	.20	53,500	97,000	21.5	34.0	.20, .23*	Silky; trace of granulation.
23FG	.505	.20	53,000	96,000	21.5	34.0	.22*, .21*	Silky.
32FG	.505	.20	53,500	96,000	22.5	37.1	.14, .31*	Do.

5-INCH R. F. GUNS

RECOIL BANDS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds*	*Pounds.*	*Per ct.*	*Per ct.*	″ ″	
$5R_1RB$	.505	.20	53,000	115,950	16.0	20.5	.19*, .13	Granular; silky center.
$5R_3RB$	.505	.20	53,000	114,700	15.0	20.5	.15*, .15*	Granular; silky spot.
$5R_1RB$	.505	.20	48,850	108,150	11.0	13.2	.08, .14*	Medium granular.
$5R_6RB$	.505	.20	47,300	107,600	13.0	16.9	.12, .14*	Do.
$5R_1RB$	.505	.20	50,100	107,100	17.0	30.7	.12, .22*	Granular, 50 per cent; silky, 50 per cent.
$5R_5RB$	.505	.20	50,200	107,500	16.5	30.7	.23*, .10	Do.
$5R_8RB$	.505	.20	50,500	109,000	18.0	27.4	.23*, .13	Granular, 60 per cent; silky, 40 per cent.
$5R_{12}RB$	.505	.20	51,000	111,000	16.5	27.4	.22*, .11	Granular, 50 per cent; silky, 50 per cent.
$5R_{13}RB$	.505	.20	52,000	107,600	18.0	30.7	.22*, .14	Do.
$5R_{16}RB$	.505	.20	41,500	105,500	19.5	34.0	.12, .27*	Silky; trace of granulation.
$5R_{16}RBL$	.505	.20	60,500	116,600	17.0	34.0	.18*, .16*	Do.
$5R_{16}RB$	.505	.20	59,800	120,000	13.5	20.5	.08, .19*	Granular, 80 per cent; silky, 20 per cent.
$5R_{17}RB$	.505	.20	60,500	113,500	15.0	27.4	.21*, .09	Granular, 75 per cent; silky, 25 per cent.
$5R_{21}RB$	.505	.20	63,500	116,000	17.0	30.7	.10, .24*	Do.
$5R_{16}RB$	.505	.20	53,000	108,000	19.0	27.4	.25*, .13	Granular, 60 per cent; silky, 40 per cent.
$5R_{17}RB$	.505	.20	53,000	106,500	19.5	30.7	.26*, .13	Granular, 50 per cent; silky, 50 per cent.
$5R_{22}RB$	.505	.20	60,840	100,380	25.0	47.8	.30*, .20	Fine silky.

No. 10671.

TENSILE TEST OF STEEL PLATE FROM 6-INCH GUN SEGMENT.

Gauged length, 5″.

Mark on specimen.	Dimensions.		Sectional area.	Elastic limit.		Tensile strength.		Elongation in 5 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	Width.	Thickness.		Total.	Per square inch.	Total.	Per square inch.						
	Inches.	*Inch.*	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inches.*	*Per ct.*	*Square inch.*	*Per ct.*		″ ″ ″ ″ ″
55	2.16	.154	.33	18,380	55,700	22,100	66,970	1.35	27.0	1.73×.11=.19	42.4	Silky....................	.16, .48* .43*, .16, .12

CHEMICAL ANALYSIS.

Carbon.	Manganese.	Silicom.	Sulphur.	Phosphorus.
.20	.48	.02	.025	.014

10-INCH RIFLE.

BREECHBLOCKS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	″ ″	
1BB........	.505	.20	79,000	121,000	16.5	40.3	.25*, .08	Silky.
2BB........	.505	.20	69,000	111,800	21.0	49.1	.30*, .12	Do.
3BB........	.505	.20	74,500	119,500	20.5	46.2	.15, .26*	Do.
1BB........	.505	.20	85,000	140,500	13.0	34.0	.05, .21*	Granular; silky center.
2BB........	.505	.20	84,500	137,500	12.5	27.4	.18*, .07	Do.
2BB2........	.505	.20	65,000	110,250	19.5	46.2	.10, .29*	Silky.
2BB3........	.505	.20	90,000	136,000	15.0	34.0	.22*, .08	Granular; silky center.

SPECIMENS FROM GUN-LEVER AXLE, 10-INCH DISAPPEARING CARRIAGE, MODEL 1901.

FORGING NO. 5700.

No. of test.	Mark on specimen.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
				Total.	Per square inch.	Total.	Per square inch.						
		Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inches.*	*Per cent.*		*Per cent.*		
10681	1	.358	.10	4,260	42,600	9,320	93,200	.38	19.0	.30 diam.=.07	30.0	Granular; in part silky.......	.24*,.14
....	2	.357	.10	4,260	42,600	9,280	92,800	.44	22.0	.28 diam.=.06	40.0	Silky..........................	.19, .25*

SPECIMENS FROM STEEL FORGINGS.

STEMS OF SPECIMENS 2″ LONG, ″.505 DIAMETER.

FROM BOSTON FORGE COMPANY.

Mark.	Description.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Pounds	*Pounds.*	*Per ct.*	*Per ct.*	″ ″	
I	....	47,000	89,800	25.0	43.3	.33*,.17	Silky.
III	....	47,500	89,500	26.0	43.3	.19, .33*	Do.
....	....	50,500	82,000	26.0	46.2	.36*,.16	Do.

FROM BUILDERS IRON FOUNDRY.

EP1	....	60,500	98,500	23.5	34.0	.23, .24	Fine granular; silky spot at circumference.
RCI	....	42,500	67,350	34.5	62.2	.41*,.28	Fine silky; cup-shaped.

FROM FORE RIVER SHIP AND ENGINE COMPANY.

55F_1-MLI	Boring bar for Watervliet Arsenal.	52,000	91,500	19.0	46.2	.08, .30*	Silky.
56F_1-BLI	Rifling bar for Water vliet Arsenal.	43,500	83,500	23.0	49.1	.34*,.12	Do.
56F_1-MLI	...do..........	47,500	88,000	20.5	49.1	.09, .32*	Do.
55F_1-BLI	Boring bar for Watervliet Arsenal.	53,000	95,500	19.0	37.1	.28*,.08	Do.
56F_1-BLI$_2$	Rifling bar for Watervliet Arsenal.	62,000	97,500	17.5	37.1	.25*,.10	Do.
56F_1-MLI$_2$	...do..........	58,000	94,000	19.5	46.2	.14, .25*	Do.

FORGED STEEL FOR GUN CARRIAGES. FROM ARSENAL SMITH SHOP.

Description.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″	
4.7-inch siege carriage	48,500	80,000	24.0	46.2	.16, .32*	Fine silky.
Do...............	51,500	90,000	26.0	46.2	.18, .34*	Do.
Do...............	52,500	89,000	26.0	49.1	.26*,.26*	Do.
Do...............	62,500	89,000	28.0	54.6	.36*,.20	Silky.
Do...............	62,000	89,500	27.5	54.6	.37*,.18	Do.
6-inch barbette carriage.	64,500	100,500	24.0	43.3	.19, .29*	Do.
Do...............	68,000	93,600	24.5	44.6	.18, .31*	Fine silky.
Do...............	64,000	92,800	25.5	41.9	.33*,.18	Do.
Do...............	69,000	114,500	21.0	40.3	.23*,.19*	Silky.
Do...............	69,500	106,500	21.5	40.3	.12, .31*	Fine silky.
6-inch disappearing carriage.	57,000	114,400	18.5	37.1	.25*,.12	Silky.
Do...............	49,900	107,600	19.0	30.7	.19*,.19*	Silky and granular.
Do...............	59,800	115,450	18.5	37.1	.25*,.12	Silky.
Do...............	61,350	109,200	18.5	40.3	.10, .27*	Do.
Do...............	57,700	112,300	19.5	37.1	.27*,.12	Do.
Do...............	48,350	100,350	19.0	34.0	.27*,.11	Do.

SPECIMENS FROM STEEL FORGINGS—Continued.

Stems of Specimens 2″ Long, ″.505 Diameter—Continued.

FORGED STEEL FOR GUN CARRIAGES. FROM ARSENAL SMITH SHOP—Continued.

Description.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″	
6-inch disappearing carriage.	56,000	99,900	23.0	40.3	.31*, .15	Silky; trace of granulation.
Do.	53,000	77,500	20.0	49.1	.35, .14	Silky.
Do.	52,000	102,000	21.0	37.1	.12, .30*	Silky, 50 per cent; granular, 50 per cent.
Do.	55,500	108,500	19.0	34.0	.27*, .11	Do.
Do.	53,500	105,500	18.5	34.0	.26*, .11	Silky, 25 per cent; granular, 75 per cent.
Do.	54,000	107,500	19.5	34.0	.14, .25*	Silky, 40 per cent; granular, 60 per cent.
Do.	55,500	109,500	18.0	34.0	.10, .26*	Silky, 25 per cent; granular, 75 per cent.
Do.	49,600	98,160	23.5	36.4	.21, .26*	Silky; trace of granulation.
Do.	53,200	100,800	23.5	41.9	.13, .34*	Silky.
Do.	49,760	81,520	31.5	57.0	.27, .36	Do.
Do.	59,600	112,000	21.0	39.2	.27*, .15	Silky; trace of granulation.
Do.	58,800	113,600	20.0	36.4	.28*, .12	Silky, 50 per cent; granular, 50 per cent.
Do.	59,200	112,800	21.5	41.9	.30*, .13	Silky; trace of granulation.
Do.	58,000	111,600	18.0	33.5	.12, .24*	Silky, 40 per cent; granular, 60 per cent.
Do.	60,000	115,600	19.5	36.4	.28*, .11	Do.
Do.	56,400	108,800	17.5	44.6	.07, .28*	Silky; trace of granulation.
Do.	56,000	108,000	22.0	41.9	.12, .32*	Do.
Do.	55,600	109,200	21.5	39.2	.30*, .13	Silky, 50 per cent; granular, 50 per cent.
Do.	56,800	111,880	20.0	39.2	.29*, .11	Silky, 70 per cent; granular, 30 per cent.
Do.	58,000	113,200	20.5	36.4	.29*, .12	Silky, 40 per cent; granular, 60 per cent.
Do.	59,200	114,000	17.5	33.5	.11, .24*	Silky; trace of granulation.
Do.	42,000	66,400	32.0	67.8	.17, .25, .54*	Silky.
Do.	42,400	67,600	32.7	67.8	.20, .55*, .23	Do.
Do.	66,000	113,200	19.3	44.6	.23, .24*, .11	Do.
Do.	64,000	112,800	18.7	44.6	.12, .34*, .10	Do.
Do.	64,400	113,600	16.3	39.2	.29*, .13, .07	Do.
Do.	64,000	114,000	13.3	44.6	.29*, .06, .05	Do.
Do.	68,400	112,000	18.5	47.2	.08, .35*, .12	Do.
Do.	65,400	114,000	17.7	41.9	.10, .33*, .10	Do.
Do.	60,500	113,500	19.5	37.1	.25*, .14	Silky; trace of granulation.
Do.	55,400	84,000	29.5	57.2	.41*, .18	Silky.
Do.	42,000	82,000	27.0	51.9	.38*, .16	Do.
Do.	43,500	81,500	27.5	51.9	.15, .40*	Do.
Do.	56,000	112,000	19.0	37.1	.26*, .12	Do.
Do.	60,000	114,500	20.0	37.1	.15, .25*	Do.
Do.	35,600	75,840	28.5	44.6	.22, .35*	Fine silky.
Do.	54,600	92,000	23.0	49.1	.28*, .18	Do.
Do.	35,850	54,050	42.0	71.3	.58*, .26	Do.
Do.	59,800	113,800	19.0	34.0	.13, .25*	Silky.
Do.	53,200	94,000	20.3	47.2	.12, .37*, .12	Do.
Do.	56,000	105,000	20.5	40.3	.14, .27*	Do.
Do.	58,000	114,500	18.0	37.1	.11, .25*	Do.
Do.	59,000	105,100	17.5	40.3	.09, .26*	Do.
Do.	53,000	105,000	21.0	40.3	.15, .27*	Do.
Do.	60,000	113,000	19.5	40.3	.25*, .14	Do.
Do.	52,500	107,500	16.0	30.7	.10, .22*	Granular, 60 per cent; silky, 40 per cent.
Do.	57,500	111,000	19.5	37.1	.25*, .14	Silky; trace of granulation.
Do.	47,600	104,400	17.0	40.0	.17,	Silky.
Do.	56,500	103,000	23.0	37.1	.16, .30*	Do.
Do.	53,000	106,000	18.5	37.1	.10, .27*	Do.
Do.	52,500	110,000	14.0	20.5	.09, .19*	Medium granular.
Do.	61,500	95,000	23.5	40.3	.29* .18	Fine silky.
Do.	54,500	107,500	20.5	37.1	.19*, .21*	Silky.

SPECIMENS FROM STEEL FORGINGS—Continued.

Stems of Specimens 2″ Long, ″.505 Diameter—Continued.

FORGED STEEL FOR GUN CARRIAGES. FROM ARSENAL SMITH SHOP—Continued.

Description.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″	
8-inch disappearing carriage.	54,000	109,000	17.5	27.4	.23, .12	Granular, 70 per cent; silky, 30 per cent.
Do	62,500	100,500	23.0	34.0	.21*,.23*	Silky.
Do	48,500	99,500	23.0	40.3	.29*,.17	Silky and granular.
Do	56,000	109,500	19.0	34.0	.12, .26*	Do.
8-inch barbette carriage.	58,500	106,000	20.5	40.3	.29*,.11	Silky.
Do	53,500	88,500	26.5	49.1	.17, .36*	Do.
Do	47,000	91,000	26.0	46.2	.25*,.27*	Do.
Do	54,000	89,500	25.5	46.2	.26*, 25*	Do.
Do	55,500	102,000	22.0	43.3	.31*,.13	Do.
10-inch disappearing carriage.	52,000	97,500	22.5	37.1	.13, .32*	Silky and granular.
Do	61,000	99,000	24.5	51.9	.13, .36*	Fine silky.
Do	61,850	100,350	27.0	49.1	.18, .36*	Do.
Do	65,500	102,350	26.0	49.1	.30*,.22	Do.
Do	57,200	102,950	21.5	37.1	.13, .30*	Silky.
Do	58,000	102,400	25.5	49.1	.17, .34*	Fine silky.
Do	56,000	105,000	23.0	46.2	.16, .30*	Do.
Do	62,500	100,500	25.0	46.2	.33*,.17	Fine granular.
Do	68,500	103,000	25.0	46.2	.16, .34*	Silky.
Do	44,000	58,000	39.0	66.9	.50*,.28	Do.
Do	58,000	111,000	18.0	37.1	.23*,.13	Do.
Do	46,000	81,600	30.0	54.6	.42*,.18	Do.
Do	51,000	83,500	30.0	54.6	.34*,.26	Do.
Do	68,000	113,200	18.0	39.2	.14, .30*,.10	Do.
Do	62,800	109,200	19.7	41.9	.13, .34*,.12	Do.
Do	58,500	105,500	18.5	37.1	.11, .26*	Fine silky.
Do	48,000	102,500	19.5	37.1	.12, .27*	Dull gray; irregular.
Do	44,000	94,500	20.5	37.1	.30*,.11	Silky.
Do	56,000	95,000	24.5	37.1	.26*,.23*	Do.
Do	52,500	109,000	17.0	37.1	.09, .25*	Do.
10-inch mortar carriage.	69,000	114,500	23.5	51.9	.32*,.15	Do.
12-inch disappearing carriage.	50,800	95,600	20.3	36.4	.15, .32*,.14	Silky; trace of granulation.
Do	54,800	98,480	22.5	39.2	.30*,.15	Silky.
Do	55,600	97,200	24.0	44.6	.15, .33*	Do.
Do	56,200	97,680	20.0	41.9	.10, .30*	Do.
Do	53,000	100,350	22.0	37.1	.22*,.22*	Do.
Do	58,000	106,500	23.0	52.2	.11, .18, .40*	Fine silky.
Do	54,000	108,500	24.0	52.2	.23, .35*,.14	Do.
Do	46,000	84,000	27.5	54.6	.39*,.16	Do.
Do	53,500	100,500	19.0	40.3	.11, .27*	Silky.
Do	56,500	108,500	20.0	37.1	.18*,.22*	Silky and fine granular.
Do	64,500	101,000	18.0	30.7	.10, .26*	Silky.
Do	58,800	91,600	29.0	52.2	.29*,.29*	Fine silky.
Do	64,800	108,400	23.0	41.9	.22*,.24*	Do.
Do	59,500	117,000	17.5	37.1	.24*,.11	Silky.
Do	60,500	108,000	20.5	40.3	.14, .27*	Do.
Do	58,500	109,000	20.5	37.1	.21*,.20*	Do.
Do	49,500	97,000	21.0	40.3	.28*,.14	Do.
Do	51,500	104,500	20.5	37.1	.14, .27*	Do.
12-inch mortar carriage.	54,000	103,500	22.0	40.3	.17, .27*	Do.
Do	48,000	98,500	20.5	37.1	.21*,.20*	Do
Do	67,500	107,500	21.0	37.1	.21*,.21*	Do.

SPECIMENS FROM STEEL FORGINGS—Continued.

Stems of Specimens 2″ Long, ″.505 Diameter—Continued.

STEEL INGOTS CAST AT WATERTOWN ARSENAL AND FORGED IN ARSENAL SMITH SHOP.

Description.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″	
10-inch ingot	61,000	101,000	24.5	51.9	.32*, .17	Fine silky; cup-shaped.
10-inch ingot	64,500	103,500	5.5	5.7	.06*, .05	Granular.
15-inch ingot	67,000	115,500	19.0	43.3	.12, .24*	Silky.
9.5-inch ingot	57,500	95,500	23.0	49.1	.11, .35*	Fine silky.

FOR WATERVLIET ARSENAL.

Breechblocks	96,000	134,000	13.0	30.7	.08, .18*	Granular; silky center.
Do	84,000	123,250	16.0	40.3	.09, .23*	Silky.

FORGED STEEL FROM BOSTON FORGE COMPANY.

1	53,000	101,000	20.5	40.3	.11, .30*	Silky.
2	54,500	99,000	20.5	40.3	.29*, .12	Do.
3	54,000	99,500	23.0	40.3	.15, .31*	Do.
4	51,500	99,500	22.5	34.0	.24*, .21	Silky; in part granular.
5	46,500	95,500	22.0	34.0	.28*, .16	Silky.
6	47,000	94,000	21.5	37.1	.15, .28*	Do.

SPECIMENS FROM STEEL FORGINGS—Continued.

STEEL SPECIMEN FROM ENGINEER CORPS, U. S. ARMY, SAVANNAH, GA., OFFICE.

No. of test.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 3 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
			Total.	Per square inch.	Total.	Per square inch.						
	Inch.	*Sq. inch*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inches.*	*Per cent.*	*Sq. inch.*	*Per cent.*		
10564	0.505	0.20	7,300	36,500	11,100	55,500	1.00	33.3	0.0616	69.2	Fine, silky..................................	".23, ".56*, ".21

FRAGMENTS OF THE 12-INCH NICKEL-STEEL TUBE BURST AT SANDY HOOK PROVING GROUND BY A 12-INCH ISHAM SHELL.

RADIAL TENSILE SPECIMENS.

STEMS 2" LONG, ".505 DIAMETER.

Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
64,000	88,200	15.0	20.5	.11, .19*	Dull silky; serrated.
71,000	92,100	14.0	37.1	.23*, .05	Silky; irregular surface.
59,500	88,100	12.5	20.5	.13*, .12	Do.
58,000	88,500	14.5	30.7	.07, .22*	Do.
57,000	88,100	16.0	34.0	.08, .24*	Do.
77,500	94,500	10.0	27.4	.02, .18*	Do.
61,000	89,000	13.5	20.5	.16, .21*	Do.
65,000	89,100	15.5	37.1	.06, .25*	Do.
64,000	90,500	15.0	27.4	.09, .21*	Do.
64,500	90,000	14.0	34.0	.05, .23*	Do.
71,000	94,500	10.0	23.9	.18*, .02	Do.
78,000	92,500	13.0	30.7	.06, .20*	Do.
69,000	92,000	11.0	16.9	.07, .15*	Silky, 30 per cent; granular, 70 per cent.
71,000	91,000	13.5	34.0	.04, .23*	Silky; irregular surface.
68,000	91,600	13.5	23.9	.22*, .15	Do.
63,500	89,100	11.5	16.9	.11*, .12	Do.
63,000	88,500	15.0	37.1	.06, .24*	Do.
64,000	89,700	14.0	20.5	.15*, .13	Do.
84,000	95,600	12.0	30.6	.04, .20*	Silky; oblique.
78,000	93,200	16.0	39.2	.08, .24*	Silky, irregular; opened cracks in stem.
68,800	90,400	18.0	41.9	.24*, .12	Silky.
66,400	89,600	18.0	41.9	.25*, .11	Silky; irregular.

LONGITUDINAL TENSILE SPECIMENS.

100,800	105,600	17.0	54.6	.30*, .04	Fine silky; cup-shaped.
84,400	94,000	22.5	57.0	.18, .27*	Do.
72,800	89,920	26.0	59.3	.36*, .16	Do.
70,000	89,000	27.5	61.5	.37*, .18	Do.

TANGENTIAL TENSILE SPECIMENS.

88,400	93,920	27.0	41.9	.27	Silky.
90,800	95,200	18.0	21.4	.18	Silky; serrated.
....	12,400	0.0	0.0	.00	Silky, serrated, 4 per cent; dark granular, 96 per cent.
79,200	79,200	1.0	1.5	.01	Granular; dark colored, 25 per cent.

STEEL CASTINGS, GUN AND CARRIAGE WORK.

MATERIAL FROM ISAAC G. JOHNSON & CO.

3-INCH FIELD CARRIAGES, MODEL 1902.

SPECIMENS FROM STEEL CASTINGS.

STEMS OF SPECIMENS 2" LONG, ".505 DIAMETER.

ELEVATING GEAR BRACKETS.

Marks.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
12/17-2-10	34,500	67,000	28.5	46.2	.23, .34*	Silky.
12/17-2-2	34,000	67,500	29.0	43.3	.36*, .22	Do.
12/17-2-21	33,500	67,500	29.0	46.2	.26, .32*	Do.
12'19-2-24	36,600	73,870	27.0	41.8	.26*, .28*	Do.
1/5-2-60	35,050	76,290	23.5	32.0	.18, .29*	Do.
1/5-2-23	40,210	80,930	19.5	18.0	.20*, .19	Granular; silky spot at circumference.
1/2-2-55	38,040	76,080	24.5	28.4	.22, .27*	Silky.
1 2-2-35	34,850	72,370	25.5	41.8	.32*, .19	Do.
1 2-2-37	36,960	71,290	28.0	41.8	.30*, .26	Do.
12 30-2-26	36,440	71,800	25.5	38.7	.20, .31*	Do.
1/7-3-34	44,850	87,890	20.0	25.3	.22*, .18	Granular; silky spot at circumference.
1/5-2-20	37,530	76,550	26.0	41.8	.29*, .23	Silky.

6-INCH R. F. GUN CARRIAGES, MODEL 1900.

SPECIMENS FROM STEEL CASTINGS.

STEMS OF SPECIMENS 2" LONG, ."505 DIAMETER.

PLATFORM BRACKETS.

Marks.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
10/20-2/4	36,900	94,100	11.5	13.2	.10, .13*	Granular.
10/21-2/3	37,400	80,600	25.0	37.1	.24*, .26*	Silky.
10/22-2/5	42,100	83,950	15.0	16.9	.14, .16	Granular; silky spot at circumference.
10/27-2/2	40,000	84,200	14.0	16.9	.15*, .13	Do.
10/28-2/1	38,450	84,700	22.5	34.0	.18, .27*	Silky; trace of granulation.
10/29-2/6	38,450	81,100	24.0	34.0	.28*, .20	Do.
11/12-2-7	39,000	73,600	26.0	37.1	.31*, .21	Silky.
11/11-2-10	45,500	85,200	24.0	37.1	.31*, .17	Do.
11/10-2-11	52,000	94,650	15.5	20.5	.17*, .14	Granular; silky spot at circumference.
11/7-2-12	36,500	73,500	27.5	34.0	.29*, .26*	Silky.
11/9-2-8	49,000	95,100	17.5	20.5	.19*, .16	Granular; silky spot at circumference.
11/6-2-9	45,000	85,000	18.0	20.5	.17*, .19*	Do.
11/5-2-13	45,000	86,100	19.5	20.5	.21*, .18	Do.
10/30-2-14	40,500	82,900	17.5	16.9	.16, .19*	Do.
11/4-2-15	41,500	81,800	24.5	37.1	.19, .30*	Silky.
11/16-2-1	39,500	80,900	25.0	34.0	.20, .30*	Silky, 85 per cent; granular, 15 per cent.
11/26-2-3	37,500	80,500	24.0	30.7	.30*, .18	Granular, 75 per cent; silky, 25 per cent.
11/21-2-11	39,500	80,500	23.5	23.9	.21, .26*	Granular, 85 per cent; silky, 15 per cent.
11/28-2-9	37,000	79,000	28.0	30.7	35*, .21	Granular, 50 per cent; silky, 50 per cent.
11/20-2-2	49,500	99,000	17.0	20.5	.13, .21*	Granular; silky spot at circumference.
11/30-2-4	49,000	92,000	22.5	27.4	.17, .28*	Granular, 80 per cent; silky, 20 per cent.
11/19-2-5	39,750	84,500	21.5	20.5	.19, .24*	Granular; silky spot at circumference.
11/29-2-12	42,000	85,500	18.0	16.9	.16, .20*	Granular, 75 per cent; silky, 25 per cent.
11/27-2-6	45,500	92,000	21.5	23.9	.18, .25*	Granular; silky spot at circumference.
11/23-2-7	38,000	83,000	21.5	20.5	.24*, .19	Granular, 75 per cent; silky, 25 per cent.
11/30-2-10	46,000	90,500	23.0	30.7	.18, .28*	Granular, 70 per cent; silky, 30 per cent.
11/25-2-8	35,500	79,000	25.0	34.0	.32*, .18	Granular, 50 per cent; silky, 50 per cent.
11/16-2-14	37,500	79,000	21.5	23.9	.18, .25*	Granular, 80 per cent; silky, 20 per cent.
12/11-3-18	38,000	75,500	26.0	34.0	.29*, .23	Silky; trace of granulation.
11/18-2-19	49,500	95,500	17.0	20.5	.19, .15	Granular, 80 per cent; silky, 20 per cent.
11/17-2-17	40,000	81,000	25.0	30.7	.27*, .23	Granular, 60 per cent; silky, 40 per cent.
12/5-2-13	43,500	87,500	14.0	13.2	.11, .17*	Granular; silky spot at circumference.
12/5-2-20	46,000	94,500	17.0	20.5	.16, .18*	Do.
12/7-3-16	38,500	82,000	25.0	34.0	.28*, .22	Silky; trace of granulation.
12/8-3-15	37,500	80,000	27.0	30.7	.23, .31*	Silky.
11/17-2-19	43,500	87,000	15.0	13.2	.14, .16*	Granular; silky spot at circumference.
10/31-2-16	41,000	81,000	25.5	34.0	.20, .31*	Granular, 50 per cent; silky, 50 per cent.
11/13-2-18	44,000	81,000	16.5	16.9	.17*, .16	Granular; silky spot at circumference.
11/16-2-17	48,500	93,000	20.5	23.9	.19, .22*	Granular, 80 per cent; silky, 20 per cent.

6-INCH R. F. GUN CARRIAGES, MODEL 1900—Continued.

SPECIMENS FROM STEEL CASTINGS—Continued.

STEMS OF SPECIMENS 2″ LONG, .″505 DIAMETER—Continued.

PLATFORM BRACKETS—continued.

CHEMICAL ANALYSES.

Marks.	Carbon.	Manganese.	Silicon.	Phosphorus.
11/9-2-8	.440	.702	.464	.040
11/7-2-12	.440	.697	.350	.041

SHOULDER REST AND ELEVATING WORM-WHEEL COVER.

Marks.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	″ ″	
*	44,000	108,500	11.0	9.5	.12*, .10	Granular.
**	39,500	83,000	8.5	9.5	.08, .09*	Granular; dull, silky spot at circumference.

STANDARD BRACES.

11/28-2-7	39,500	84,000	21.5	30.7	.28*, .15	Granular, 75 per cent; silky, 25 per cent.
11/20-2-2	44,500	94,500	17.5	16.9	.19*, .16	Granular; silky spot at circumference.
11/24-2-4	37,000	79,500	26.5	30.7	.21, .32*	Granular, 80 per cent; silky, 20 per cent.
11/24-2-5	36,500	80,500	25.0	34.0	.21, .29*	Granular, 30 per cent; silky, 70 per cent.
11/28-2-8	37,000	82,500	23.0	30.7	.18, .28*	Granular, 70 per cent; silky, 30 per cent.
11/19-2-1	39,000	84,500	23.5	30.7	.26*, .21	Granular, 50 per cent; silky, 50 per cent.
11/28-2-6	37,500	82,000	23.5	30.7	.28*, .19	Granular, 75 per cent; silky, 25 per cent.
11/23-3-3	37,000	77,500	18.0	20.5	.20*, .16	Granular; silky spot at circumference.
12/2-2-14	44,500	90,500	17.0	20.5	.16, .18*	Granular.
11/27-2-9	42,500	90,000	21.0	34.0	.28*, .14	Granular, 50 per cent; silky, 50 per cent.
12/4-2-18	44,000	88,000	17.5	20.5	.16, .19*	Granular; silky spot at circumference.
12/3-3-13	38,000	80,500	25.0	34.0	.24, .26*	Granular, 25 per cent; silky, 75 per cent.
11/30-2-11	42,000	89,000	22.0	30.7	.21, .23*	Granular, 20 per cent; silky, 80 per cent.
12/2-2-16	41,000	91,000	19.0	23.9	.17, .21*	Granular, 75 per cent; silky, 25 per cent.
11/30-2-12	43,500	90,500	21.5	27.4	.24*, .19	Granular, 50 per cent; silky, 50 per cent.
12/4-2-17	41,000	87,500	19.5	23.9	.20*, .19	Granular; silky spot at circumference.
12/2-2-15	44,500	91,500	17.0	20.5	.14, .20*	Do.
12/4-2-19	41,000	89,000	19.0	20.5	.20*, .18	Do.
11/30-2-10	41,000	88,000	22.5	34.0	.25* .20	Granular, 40 per cent; silky, 60 per cent.

6-INCH R. F. GUN CARRIAGES, MODEL 1900—Continued.

SPECIMENS FROM STEEL CASTINGS—Continued.

STEMS OF SPECIMENS 2" LONG, .''505 DIAMETER—Continued.

REAR CYLINDER HEADS.

Marks.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
11/21-2-4	31,000	76,000	27.0	37.1	.33*, .21	Granular, 60 per cent; silky, 40 per cent.
11/27-2-20	43,500	91,000	23.0	30.7	.17, .29*	Granular, 80 per cent; silky, 20 per cent.
11/24-2-10	37,500	80,500	25.0	30.7	.23, .27	Granular, 60 per cent; silky, 40 per cent.
11/19-2-1	38,500	84,000	24.5	34.0	.20, .29*	Granular, 40 per cent; silky, 60 per cent.
11/28-2-18	38,000	84,500	23.0	27.4	.25*, .21	Granular, 75 per cent; silky, 25 per cent.
11/24-2-14	36,000	80,000	24.0	34.0	.19, .29*	Granular, 80 per cent; silky, 20 per cent.
11/25-3-8	34,000	77,000	25.5	34.0	.32*, .19	Granular, 25 per cent; silky, 75 per cent.
11/23-3-6	34,500	77,000	17.5	20.5	.18*, .17	Granular; silky spot at circumference.
11/28-2-15	38,000	84,000	25.0	30.7	.31*, .19	Silky; trace of granulation.
11/24-2-13	37 000	81,000	23.0	30.7	.18, .28*	Silky, 50 per cent; granular, 50 per cent.
11/27-2-17	48,500	93,000	21.5	27.4	.27*, .16	Silky, 25 per cent; granular, 75 per cent.
11/21-2-3	34,500	78,000	26.0	37.1	.23, .29*	Silky; trace of granulation.
11/27-2-19	43,500	89,500	23.5	30.7	.18, .29	Silky, 25 per cent; granular, 75 per cent.
11/21-2-5	37,000	79,500	25.0	30.7	.23, .27*	Silky; trace of granulation.
11/19-2-9	39,000	82,500	25.0	30.7	.33*, .17	Silky, 50 per cent; granular, 50 per cent.
11/21-2-7	36,000	78,000	28.0	37.1	.23, .33*	Do.
11/25-3-12	37,500	77,000	27.5	34.0	.31*, .24	Silky, 70 per cent; granular, 30 per cent.
11/24-2-11	37,500	80,000	24.0	34.0	.20, .28*	Silky, 80 per cent; granular, 20 per cent.
11/19-2-2	38,500	84,500	23.0	30.7	.26*, .20	Granular; silky spot at circumference.
11/28-2-16	40,500	84,500	24.0	34.0	.23, .25	Granular, 20 per cent; silky, 80 per cent.

AXLE CAPS.

12/4-2-20	37,000	77,500	14.5	13.2	.15*, .14	Granular; silky spot at circumference.
12/2-3-17	36,000	78,500	15.0	16.9	.16*, .14	Do.
12/1-2-14	41,000	85,500	14.5	16.9	.15*, .14	Do.
12/1-2-12	36,000	76,000	24.0	34.0	.24*, .24*	Silky; trace of granulation.
12/2-2-15	39,500	82,500	17.0	20.5	.19*, .15	Silky, 30 per cent; granular, 70 per cent.
11/23-2-1	32,000	70,500	26.0	37.1	.32*, .20	Silky, 85 per cent; granular, 15 per cent.
12/1-2-13	43,500	87,500	13.5	16.9	.15*, .12	Granular; silky spot at circumference.
11/30-3-11	35,500	77,000	15.0	16.9	.14, .16*	Do.
11/24-2-3	35,500	77,500	22.0	23.9	.26*, .14	Granular, 60 per cent; silky, 40 per cent.
12/24-2-4	40,000	87,500	18.5	20.5	.19*, .18	Granular; silky spot at circumference.
11/30-3-9	39,500	81,500	17.5	20.5	.20*, .15	Do.
11/24-2-5	35,000	77,000	19.5	23.9	.22*, .17	Granular, 50 per cent; silky, 50 per cent.
12/2-2-16	42,500	89,500	16.5	23.9	.15, .18*	Granular, 60 per cent; silky, 40 per cent.
11/28-2-7	42,000	82,000	14.5	16.9	.13, .16*	Granular; silky spot at circumference.
12/4-2-19	37,500	77,000	16.0	16.9	.17*, .15	Do.
12/3-3-18	40,500	82,000	17.0	20.5	.15, .19*	Do.

MATERIAL FROM THE ARSENAL TROPENAS STEEL CASTING PLANT.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch	Elongation	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
1	.18	.42	.210	.057	.070	43,500	67,500	30.5	46.2	.40*, .21	Silky.
	......	......	......	......	......	30,600	72,800	21.3	27.6	.17, .30*, .17	Irregular; amorphous.
2	.28	.75	.282	.047	.046	49,000	79,000	15.5	20.5	.17*, .14	Granular, 45 per cent; gray, 55 per cent.
	......	......	......	......	......	38,000	73,500	19.5	27.4	.24*, .15	Silky; oblique; sand spots.
	......	......	......	......	......	41,600	75,600	18.0	21.4	.20*, .16	Gray; amorphous.
3	.22	.42	.188	.045	.045	30,500	63,000	28.5	37.1	.31*, .26	Silky; irregular.
	......	......	......	......	......	32,500	63,500	25.5	37.1	.29*, .22	Silky; sand spot.
4	.32	.65	.310	.046	.048	37,500	73,000	27.5	37.1	.19, .36*	Silky; oblique.
	.25	.75	.320	.045	.048	46,000	79,500	20.5	23.9	.27*, .14	Silky, 40 per cent; granular, 60 per cent.
5	.30	.94	.390	.043	.060	47,500	81,500	25.0	34.0	.27*, .24	Silky.
	.25	.84	.390	.047	.060	42,500	81,000	30.0	49.1	.31*, .29	Fine silky.
	......	......	......	......	......	47,000	80,000	29.0	49.1	.23, .35*	Silky.
	......	......	......	......	......	47,000	81,000	28.0	49.1	.18, .38*	Do.
	......	......	......	......	......	53,500	88,000	18.5	20.5	.20*, .17	Gray; amorphous.
6	.33	1.06	.360	.045	.052	52,500	93,500	25.0	40.3	.27*, .23	Silky.
	.25	.75	.404	.045	.048	......	......	......	......	......	
7	.33	1.04	.404	.045	.048	35,000	69,500	29.5	37.1	.36*, .23	Do.
8	.35	1.20	......	......	......	61,000	101,500	22.5	43.3	.21, .24*	Fine silky.
	.27	1.20	......	......	......	49,000	80,500	25.5	43.3	.29*, .22	Do.
	.21	.48	.21	......	......	51,500	89,000	20.5	37.1	.23*, .20	Do.
9	.34	.75	......	......	......	49,000	85,000	20.0	27.4	.19, .21*	Dull silky.
10	.32	.80	......	......	......	43,500	73,500	19.5	37.1	.27*, .12	Silky.
	.26	.89	......	......	......	38,000	80,500	24.0	30.7	.23*, .25*	Granular, 55 per cent; silky, 45 per cent.
	......	......	......	......	......	45,000	71,500	9.0	20.5	.05, .13*	Silky, 90 per cent; black amorphous, 10 per cent.
	......	......	......	......	......	48,000	81,000	17.5	20.5	.19*, .16	Silky.
	......	......	......	......	......	39,000	68,500	15.5	27.4	.12, .19*	Dull silky; opened cracks.
	......	......	......	......	......	36,500	75,000	10.5	13.2	.09, .12*	Granular; opened cracks.
11	.36	.86	.445	.034	.036	56,000	100,500	20.5	34.0	.17, .24*	Silky.
12	.46	1.04	.432	.040	.038	59,000	99,500	17.0	13.2	.07*, .07	Granular; cavity.
	......	......	......	......	......	59,000	106,500	12.0	13.2	.12*, .12	Granular.
	......	......	......	......	......	58,000	105,500	15.5	20.5	.19*, .12	Granular, in part silky.
	......	......	......	......	......	54,000	106,000	14.5	20.5	.12, .17*	Granular, 60 per cent; silky, 40 per cent.
	......	......	......	......	......	54,500	107,000	15.0	20.5	.16*, .14	Granular; silky spot.
13	.25	.64	.379	.044	.040	29,000	66,000	28.0	46.2	.26, .30*	Silky.
	.46	.94	.379	.045	.040	61,000	116,500	16.5	27.4	.12, .21*	Silky and fine granular.
14	.28	.94	.372	......	.089	58,000	94,500	19.0	27.4	.16, .22*	Silky.
15	.25	.66	.325	.028	.142	......	......	......	......	......	
16	.36	.76	.392	.025	.220	......	......	......	......	......	
17	.40	.90	.345	.031	.280	......	......	......	......	......	
18	.26	.82	.263	.019	.144	......	......	......	......	......	
19	.34	.85	.253	.036	.158	58,500	79,500	4.0	5.7	.03, .05*	Granular; glossy spot.
20	.36	.91	.379	.022	.322	......	......	......	......	......	
21	.35	.84	.470	.033	.043	......	......	......	......	......	
22	.34	.88	.440	.035	.043	53,000	98,000	7.5	5.7	.16*, .09	Granular; opened cracks.
	......	......	......	......	......	42,000	91,000	20.5	27.4	.21*, .20	Silky; in part granular.
	......	......	......	......	......	47,500	94,000	20.0	27.4	.20*, .20*	Silky.
23	.26	.82	.260	.039	.043	46,000	83,500	22.5	30.7	.23*, .22	Do.
	......	......	......	......	......	46,500	85,500	18.5	20.5	.20*, .17	Do.
24	.37	1.02	.385	.036	.038	54,500	115,000	15.0	23.9	.12, .18*	Granular; silky spot.

MATERIAL FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds	*Pounds.*	*Per cent.*	*Per cent.*	" "	
25	.34	.88	.406	.035	.037	52,500	90,500	24.0	34.0	.20, .28*	Silky.
						49,500	98,500	17.5	23.9	.17*, .18*	Do.
						39,000	83,500	26.5	43.3	.22, .31*	Do.
26	.36	1.04	.362	.038	.040						
27	.33	1.00	.264	.037	.056						
28	.35	.90	.250	.033	.048	51,500	91,500	21.0	30.7	.18, .24*	Do.
29	.33	.94	.347	.036	.042	44,000	86,500	26.0	37.1	.26*, .26*	Do.
						44,000	78,000	24.0	37.1	.18, .30*	Do.
30	.25	.91	.389	.030	.043	45,000	86,000	20.5	30.7	.15, .26*	Do.
						43,500	73,500	11.0	16.9	.08, .14*	Silky; oblique; sand spot.
31	.34	.93	.426	.031	.040	49,700	90,500	22.5	43.3	.32*, .13	Silky.
						56,500	101,500	16.5	20.5	.14, .19*	Silky, 60 per cent; granular, 40 per cent.
						61,000	104,500	17.5	20.5	.15, .20*	Silky and fine granular.
32	.33	.88	.248	.025	.035	44,000	90,500	17.0	20.5	.15, .19*	Granular, 80 per cent; silky, 20 per cent.
33	.34	.89	.272	.031	.039	51,500	92,500	9.0	9.5	.10*, .08	Silky, 20 per cent; granular, 80 per cent.
	.25	.90	.272	.031	.039	60,500	103,000	19.5	34.0	.15, .24*	Silky.
						39,000	71,500	22.5	30.7	.18, .27*	Do.
34	.35	.88	.304	.037	.040	46,500	89,500	16.0	20.5	.17*, .15	Silky; trace of granulation.
						49,000	90,000	20.5	27.4	.16, .25*	Silky, 50 per cent; granular, 50 per cent.
35	.34	.88	.347	.037	.042	42,000	90,000	20.5	34.0	.20*, .21*	Silky.
36	.26	.75	.338	.035	.042	56,000	100,500	10.0	13.2	.08, .12*	Granular; silky spot.
	.36	.84	.338	.035	.042	55,300	99,500	13.0	16.9	.12, .14*	Silky, 40 per cent; granular, 60 per cent.
37	.33	.75	.304	.035	.043	43,500	83,500	14.5	16.9	.11, .18*	Silky, 30 per cent; granular, 70 per cent.
						36,000	77,500	16.5	16.9	.13, .20*	Granular; silky spot.
38	.36	.85	.345	.034	.044	37,000	71,000	21.5	27.4	.27*, .16	Silky.
39 40	.34	.84	.370	.030	.045						
41	.31	.82	.370	.031	.042	25,500	59,500	17.5	20.5	.19*, .16	Granular; flaky spot.
						31,000	63,500	29.0	40.3	.24, .34*	Silky; oblique.
						35,000	63,500	24.5	27.4	.26*, .23	Silky.
42	.26	.83	.366	.036	.040						
43	.25	.85	.392	.031	.039	41,500	86,500	26.0	40.3	.28*, .24	Do.
44	.24	.81	.364	.033	.039	45,000	88,000	23.0	34.0	.25*, .21	Silky, 30 per cent; granular, 70 per cent.
						44,000	89,000	23.5	37.1	.23*, .24*	Silky.
45	.35	.78	.297	.031	.041	29,000	60,500	31.5	49.1	.22, .41*	Do.
	.25	.67	.346	.031	.041	49,500	91,000	21.5	27.4	.27*, .16	Do.
						34,000	71,000	25.5	37.1	.25*, .26*	Do.
						34,500	73,000	25.5	37.1	.20, .31*	Do.
						37,000	73,000	24.0	37.1	.31*, .17	Do.
46	.27	.77		.030	.040						
47	.25	.76	.310	.042	.040	48,000	79,000	9.5	20.5	.06*, .03	Dull silky.
						48,500	82,000	23.5	30.7	.19, .28*	Silky.
48	.24	.81	.308	.048	.043	41,000	73,500	25.5	37.1	.31*, .20	Do.
	.28	.74	.308	.048	.043						
49	.28	.80	.203	.063	.051						
50	.27	.83	.290	.085	.050						
51	.25	.79	.268	.046	.050	38,000	72,000	22.5	30.7	.19*, .16	Do.
						38,000	71,500	25.5	37.1	.20, .31*	Do.
						36,500	66,500	20.0	20.5	.22*, .18	Do.
						34,000	65,500	16.3	16.9	.18*, .15	Silky; trace of granulation.
52	.26	.77	.259	.073	.049						
53	.27	.78	.250	.063	.049	34,000	72,500	26.5	40.3	.31, .22	Silky; oblique.

MATERIAL FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds	*Pounds.*	*Per cent.*	*Per cent.*	″ ″	
	.....	......	......	......	......	44,500	84,500	20.5	33.9	.15, .26*	Silky; trace of granulation.
54	.24	.71	.268	.045	.048	34,000	63,000	32.5	51.9	.30*,.35*	Silky.
	.....	......	......	......	......	42,000	69,500	29.5	40.3	.33*,.26*	Do.
55	.35	.67	.364	.043	.045	47,000	73,000	5.5	......	.05, .06	Dull gray; flaky.
	.....	......	......	......	......	62,500	95,500	12.5	16.9	.14*,.11	Dull gray; irregular.
56	.34	.70	.353	.045	.045	66,000	99,000	17.5	40.3	.26*,.09	Silky; irregular.
	.....	......	......	......	......	49,500	82,500	25.5	49.1	.21, .30*	Fine silky.
57	.24	.62	.310	.048	.044	40,500	67,500	25.0	43.3	.14, .36*	Silky.
	.....	......	......	......	......	33,500	60,000	27.5	37.1	.30*,.25*	Do.
	.....	......	......	......	......	35,500	64,500	29.0	46.2	.20, .38*	Do.
	.....	......	......	......	......	28,000	61,000	26.0	27.4	.26, .26*	Silky; irregular; opened cracks.
	.....	......	......	......	......	31.500	61,000	31.0	43.2	.31*,.31	Silky.
58	.30	.74	.362	.046	.043	48,500	93,500	22.5	40.3	.14, .31*	Do.
59	.30	.73	.353	.054	.043	......	......	......	......	......	
60	.25	.69	.364	.046	.042	50,500	90,000	24.0	40.3	.28*,.20	Do.
	.....	......	......	......	......	40,500	71,500	29.5	49.1	.20, .39*	Do.
	.....	......	......	......	......	30,500	64,000	30.5	46.2	.34*,.27	Do.
61	.29	.82	......	.046	.044	46,500	88,500	23.0	37.1	.30*,.16	Do.
62	.30	.84	......	.044	.045	48,000	88,500	24.0	37.1	.20, .28*	Do.
63	.30	.81	.282	.043	.044	48,500	87,000	20.0	30.7	.23*,.17	Do.
	.....	......	......	......	......	42,000	81,000	16.5	23.9	.14, .19*	Do.
	.....	......	......	......	......	49,000	87,500	20.0	30.7	.25*,.15	Do.
64	.25	.76	.334	.042	.045	42,000	78,500	20.0	27.4	.21*,.19*	Do.
	.....	......	......	......	......	47,500	78,000	20.5	34.0	.27*,.14	Do.
65	.30	.83	.250	.042	.043	44,500	94,500	22.0	37.1	.15, .29*	Do.
66	.24	.70	.282	.040	.043	37,500	74,500	24.5	34.0	.19, .30*	Do.
	.....	......	......	......	......	34,500	74,000	24.0	34.0	.24*,.24*	Do.
	.....	......	......	......	......	41,000	74,500	22.0	27.4	.19, .25*	Silky; trace of granulation.
	.....	......	......	......	......	36,000	73,000	23.5	30.1	.28*,.19	Silky.
	.....	......	......	......	......	34,500	76,000	19.5	23.9	.24*,.15	Dull silky.
	.....	......	......	......	......	36,500	72,000	12.5	20.5	.10, .15*	Do.
	.....	......	......	......	......	36,500	68,500	23.5	34.0	.23*,.24*	Silky.
67	.25	.62	.235	.039	.042	48,500	90,000	17.5	23.9	.20*,.15	Do.
	.30	.82	.235	.039	.042	46,000	74,500	5.0	13.2	.07*,.03	Silky; flaky.
	.....	......	......	......	......	56,500	74,000	5.0	9.5	.03, .07*	Silky; serrated.
	.....	......	......	......	......	37,500	68,500	18.0	37.1	.10, .26*	Silky.
68	.30	.75	.235	.043	.043	36,500	83,500	26.5	37.1	.25*,.28*	Do.
69	.30	.70	.260	.043	.043	45,500	90,500	21.5	37.1	.17, .26*	Do.
70	.30	.72	.263	.037	.042	47,000	87,000	23.5	37.1	.17, .30*	Do.
	.24	.70	.263	.037	.042	35,500	65,500	16.5	37.1	.09, .24*	Silky; dark spot.

CAST AND PIG IRONS.

TENACITY SPECIMENS.

TENSION TESTS OF CAST IRON.

FROM WATERTOWN ARSENAL FOUNDRY.

Description.	Tensile strength per square inch.	Fracture.
	Pounds.	
3″ shell	24,900	Fine granular, gray.
Do	22,300	Do.
Do	26,800	Do.
6″ barbette carriage	30,400	Fine granular, gray.
Do	39,330	Do.
Do	34,890	Do.
Do	28,180	Do.
Do	33,060	Do.
Do	35,100	Do.
Do	38,500	Do.
6″ disappearing carriage	28,100	Fine granular, gray.
Do	32,500	Do.
Do	30,400	Granular, gray.
Do	28,900	Do.
Do	29,100	Fine granular, light gray
Do	33,650	Granular, gray.
Do	30,780	Fine granular, light gray.
Do	34,500	Do.
Do	28,180	Do.
Do	37,000	Fine granular, gray.
Do	33,200	Fine granular, light gray.
Do	39,700	Do.
Do	39,600	Do.
Do	37,700	Granular, granitic.
Do	34,500	Granular, light gray.
Do	36,900	Fine granular, light gray.
Do	39,200	Do.
Do	37,500	Do.
Do	31,000	Granular.
Do	34,000	Do.
Do	28,000	Granular, gray.
Do	34,300	Do.
Do	35,900	Do.
Do	32,000	Do.
Do	33,900	Fine granular, light gray
Do	33,000	Do.
Do	31,500	Do.
Do	33,900	Do.
Do	38,200	Do.
Do	37,000	Do.
Do	32,400	Do.
Do	32,800	Do.
Do	36,500	Do.
Do	31,500	Fine granular. gray.
Do	37,800	Do.
Do	35,300	Do.
Do	33,900	Do.
Do	30,100	Do.
Do	29,200	Fine granular, light gray.
Do	29,900	Do.
Do	29,250	Do.
Do	28,800	Do.
Do	32,000	Fine granular, gray
Do	29,400	Granular, gray.
Do	29,100	Fine granular, light gray.
Do	34,000	Do.
Do	28,800	Do.
Do	34,200	Do.
Do	31,900	Do.
Do	30,100	Do.
Do	35,000	Do.
Do	37,200	Do.
Do	34,200	Do.
Do	33,800	Do.
Do	29,500	Do.
Do	29,500	Granular, gray.
Do	34,000	Do.
Do	38,000	Fine granular, light gray
Do	32,600	Do.
Do	33,100	Do.
Do	32,700	Do.
Do	33,300	Do.
Do	29,100	Fine granular, gray.
Do	29,100	Very fine granular, light gray.

TENSION TESTS OF CAST IRON—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

Description.	Tensile strength per square inch.	Fracture.
	Pounds.	
10″ disappearing carriage	30,600	Fine granular, gray.
Do	29,250	Do.
Do	30,680	Do.
Do	28,490	Do.
Do	30,160	Fine granular, dark gray.
Do	28,580	Do.
Do	28,500	Fine granular, gray.
Do	29,000	Granular, light gray.
Do	32,700	Do.
Do	32,800	Do.
Do	32,300	Do.
Do	29,900	Do.
12″ disappearing carriage	29,120	Fine granular, gray.
Do	28,500	Granular, gray.
Do	28,200	Do.
Do	32,400	Do.
Do	32,000	Fine granular, granitic.
Do	32,500	Do.
Do	36,500	Do.
Do	29,700	Fine granular, light gray.
Do	32,500	Do.
12″ mortar shot	31,920	Fine granular, gray.
Do	29,500	Granular, gray.
Do	34,100	Granular, light gray.
Do	30,000	Granular, gray.
Do	32,800	Do.
Do	30,900	Fine granular, granitic.
Do	34,100	Fine granular, light gray.
Do	30,800	Do.
Do	28,600	Granular, gray.
Do	35,400	Fine granular, light gray.
Do	28,200	Granular, gray.
Do	30,200	Fine granular, light gray.
Do	30,300	Fine granular, gray.
Do	32,200	Fine granular, light gray.
Do	29,220	Granular, gray.
Do	30,160	Fine granular, light gray.
Do	31,300	Do.
Do	28,800	Granular.
Do	30,300	Granular, light gray
Do	30,700	Granular, gray.
Do	34,700	Granular, light gray.
Do	31,800	Do.
12″ mortar shell	32,400	Fine granular, gray.
Do	34,100	Do.

FROM THE DETRICK & HARVEY MACHINE COMPANY.

6″ disappearing carriage, L. F. Model 1903.	27,800	Fine granular, gray.
Do	34,900	Do.
Do	34,300	Do.
Do	31,700	Do.
Do	25,900	Do.
Do	27,500	Do.
Do	27,600	Fine granular, light gray.
Do	26,400	Fine granular, light gray, with small lustrous globules.
Do	26,200	Do.
Do	27,600	Do.
Do	24,600	Do.
Do	21,900	Do.
Do	29,500	Fine granular, gray.
Do	28,900	Do.
Do	28,750	Do.
Do	33,900	Fine granular, gray; light spots.
Do	39,750	Do.
Do	37,300	Do.
Do	33,100	Do.

TENSION TESTS OF CAST IRON—Continued.

FROM THE DETRICK & HARVEY MACHINE COMPANY—Continued.

Description.	Tensile strength per square inch.	Fracture.
	Pounds.	
6″ disappearing carriage, L. F. Model 1903.	32,600	Fine granular, gray.
Do	26,500	Do.
Do	33,900	Do.
Do	27,200	Do.
Do	28,500	Do.
Do	33,900	Do.
Do	26,300	Granular, gray.
Do	33,570	Fine granular, gray.
Do	30,600	Do.
Do	35,900	Do.
Do	36,700	Do.
Do	29,200	Granular, gray.
Do	34,800	Granular, gray; light spots.
Do	35,300	Fine granular, gray.
Do	32,500	Do.
Do	29,900	Do.
Do	33,300	Do.
Do	32,900	Do.
Do	31,700	Do.
Do	32,700	Do.
Do	33,300	Do.
Do	32,900	Do.
Do	33,600	Do.
Do	29,900	Do.
Do	31,400	Do.
Do	32,200	Do.
Do	32,300	Do.
Do	29,200	Do.
Do	37,200	Fine granular, gray; light spots.
Do	31,100	Fine granular, gray.
Do	36,300	Do.
Do	26,300	Granular, gray.
Do	24,900	Do.
Do	28,100	Fine granular, gray.
Do	29,200	Do.
Do	25,800	Granular; variable.
Do	29,300	Fine granular, gray.
Do	29,400	Fine granular, light gray.
Do	30,700	Do.
Do	29,600	Do.
Do	31,200	Do.
Do	33,300	Do.
Do	33,300	Do.
Do	32,200	Do.
Do	31,400	Do.
Do	32,200	Do.
Do	29,100	Do.
Do	22,600	Do.
Do	27,100	Do.
Do	30,300	Fine granular, gray.
Do	25,100	Do.
Do	32,700	Fine granular, light gray.
Do	30,400	Do.
Do	28,200	Do.
Do	29,200	Do.
Do	28,400	Do.
Do	27,700	Do.
Do	28,800	Do.
Do	30,200	Do.
Do	29,700	Do.
Do	30,900	Do.
Do	34,600	Do.
Do	31,100	Do.
Do	34,200	Do.
Do	30,600	Do.
Do	35,500	Do.
Do	33,700	Do.
Do	21,000	Granular, gray.
Do	21,900	Do.
Do	21,400	Do.
Do	29,700	Fine granular, light gray.
Do	31,100	Do.
Do	29,300	Do.
Do	33,400	Do.
Do	33,300	Do.

TENSION TESTS OF CAST IRON—Continued.

FROM THE DETRICK & HARVEY MACHINE COMPANY—Continued.

Description.	Tensile strength per square inch.	Fracture.
	Pounds.	
6″ disappearing carriage, L. F. Model 1903.	33,200	Fine granular, light gray.
Do	31,300	Do.
Do	32,200	Do.
Do	32,000	Do.
Do	29,600	Do.
Do	28,400	Do.
Do	31,100	Do.
Do	31,100	Do.
Do	33,200	Do.
Do	28,000	Do.
Do	31,000	Do.
Do	30,500	Do.
Do	30,200	Do.
Do	28,700	Do.
Do	30,000	Do.
Do	26,900	Do.
Do	26,200	Do.
Do	28,200	Do.
Do	34,200	Do.
Do	32,900	Do.
Do	37,200	Do.
Do	35,400	Do.
Do	34,200	Do.
Do	33,400	Do.
Do	26,800	Granular, light gray.
Do	27,400	Do.
Do	27,600	Do.
Do	27,800	Do.
Do	25,500	Do.
Do	25,300	Do.
Do	33,000	Fine granular, light gray.
Do	31,200	Do.
Do	35,100	Do.

FROM C. H. COWDREY MACHINE COMPANY.

Description.	Tensile strength per square inch.	Fracture.
	20,800	Granular, gray.
	21,300	Do.
No. 1	21,200	Do.
No. 2	19,000	Do.
No. 3	21,400	Do.
From L. H. Goodnow Fdy. Co.	21,800	Medium coarse granular.
Do	22,700	Do.
Do	22,300	Do.
Do	28,100	Granular, gray.
Do	28,300	Do.
Do	28,200	Do.
Do	22,000	Do.

FROM MAJOR S. W. ROESSLER, PORTLAND, ME.

Description.	Tensile strength per square inch.	Fracture.
Cast iron with brazed butt joint.	22,400	Fine granular, gray. Fractured in head. Brazed joint not fractured.
After fracturing in the head, the stem was turned down to smaller dimensions and test completed.		
	21,200	Fractured the cast iron in the immediate vicinity of (″.01 to ″.02 from) the brazed joint.

PIG IRON.

Description.	Tensile strength per square inch.	Fracture.
Muirkirk pig	33,300	Granular, gray.
Do	30,900	Do.
Do	30,400	Do.
Do	36,100	Do.
Do	30,300	Do.
Do	33,500	Do.

CAST IRON.

ELONGATION TESTS.

CAST IRON FOR 6-INCH DISAPPEARING CARRIAGES, L. F. MODEL 1903, FROM THE DETRICK & HARVEY MACHINE CO.

No. 7864.

Chassis, left hand.
Marks, $^{\text{CHI}}_{\text{E}}$
Diameter, 1".129.
Sectional area, 1 square inch.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0011	....	
4,000	.0018	....	
5,000	.0026	....	
6,000	.0032	....	
7,000	.0039	....	
8,000	.0046	....	
9,000	.0055	....	
10,000	.0061	.0003	
11,000	.0070	....	
12,000	.0079	....	
13,000	.0088	....	
14,000	.0099	....	
15,000	.0110	.0015	
16,000	.0123	....	
17,000	.0137	....	
18,000	.0152	....	
19,000	.0169	....	
20,000	.0191	.0050	
21,000	.0219	....	
22,000	.0242	....	
23,000	.0274	.0101	
29,300	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7867.

Racer.
Marks, 2–E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load
2,000	.0007	....	
3,000	.0013	....	
4,000	.0019	....	
5,000	.0027	....	
6,000	.0034	....	
7,000	.0041	....	
8,000	.0050	....	
9,000	.0061	....	
10,000	.0069	.0008	
11,000	.0080	....	
12,000	.0091	....	
13,000	.0105	....	
14,000	.0120	....	
15,000	.0135	.0027	
16,000	.0152	....	
17,000	.0175	....	
18,000	.0200	....	
19,000	.0230	....	
20,000	.0263	.0098	
26,900	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, dark gray.

No. 7904.

Chassis, left hand.
Marks, $\overset{\text{CH4}}{\text{E}}$
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	....	
3,000	.0013	....	
4,000	.0019	....	
5,000	.0027	....	
6,000	.0034	....	
7,000	.0041	....	
8,000	.0050	....	
9,000	.0060	....	
10,000	.0071	.0008	
11,000	.0085	....	
12,000	.0098	....	
13,000	.0115	....	
14,000	.0132	....	
15,000	.0154	.0041	
16,000	.0183	....	
17,000	.0215	....	
18,000	.0260	.0108	
24,500	....	....	Tensile strength.

Fractured 4″.5 from the neck.
Appearance of fracture, medium granular.

No. 7905.

Top carriage.
Marks, 6–E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0005	....	
3,000	.0012	....	
4,000	.0019	....	
5,000	.0025	....	
6,000	.0032	....	
7,000	.0038	....	
8,000	.0047	....	
9,000	.0053	....	
10,000	.0061	.0002	
11,000	.0070	....	
12,000	.0080	....	
13,000	.0090	....	
14,000	.0100	....	
15,000	.0112	.0018	
16,000	.0130	....	
17,000	.0144	....	
18,000	.0163	....	
19,000	.0194	....	
20,000	.0209	.0068	
21,000	.0240	....	
22,000	.0275	.0109	
29,100	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7906.

Base ring.
Marks, 7–1E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0011	....	
4,000	.0018	....	
5,000	.0023	....	
6,000	.0030	....	
7,000	.0036	....	
8,000	.0041	....	
9,000	.0049	....	
10,000	.0055	.0001	
11,000	.0061	....	
12,000	.0070	....	
13,000	.0078	....	
14,000	.0088	....	
15,000	.0099	.0012	
16,000	.0110	....	
17,000	.0120	....	
18,000	.0133	....	
19,000	.0152	....	
20,000	.0170	.0045	
21,000	.0195	....	
22,000	.0220	....	
23,000	.0245	....	
24,000	.0285	.0119	
32,100	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7907.

Base ring.
Marks, 7–2E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0010	....	
4,000	.0017	....	
5,000	.0022	....	
6,000	.0029	....	
7,000	.0035	....	
8,000	.0040	....	
9,000	.0048	....	
10,000	.0056	0.	
11,000	.0062	....	
12,000	.0070	....	
13,000	.0080	....	
14,000	.0090	....	
15,000	.0100	.0010	
16,000	.0112	....	
17,000	.0128	....	
18,000	.0142	....	
19,000	.0160	....	
20,000	.0183	.0050	
20,400	....	....	Tensile strength.

Fractured in the fillet at the neck.
Appearance of fracture, granular, cold shut.
Defective specimen.

No. 7918.

Racer.
Marks, 8–1E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	....	
3,000	.0011	....	
4,000	.0018	....	
5,000	.0025	....	
6,000	.0033	....	
7,000	.0040	....	
8,000	.0050	....	
9,000	.0057	....	
10,000	.0070	.0005	
11,000	.0077	....	
12,000	.0090	....	
13,000	.0101	....	
14,000	.0117	....	
15,000	.0133	.0028	
16,000	.0152	....	
17,000	.0175	....	
18,000	.0201	....	
19,000	.0233	....	
20,000	.0271	.0113	
27,700	....	....	Tensile strength.

Fractured ″.40 from the neck.
Appearance of fracture, granular, gray.

No. 7919.

Top carriage.
Marks, 9–1E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,060	.0006	....	
3,000	.0011	....	
4,000	.0018	....	
5,000	.0022	....	
6,000	.0030	....	
7,000	.0036	....	
8,000	.0043	....	
9,000	.0050	....	
10,000	.0058	.0002	
11,000	.0066	....	
12,000	.0073	....	
13,000	.0083	....	
14,000	.0092	....	
15,000	.0104	.0015	
16,000	.0116	....	
17,000	.0128	....	
18,000	.0142	....	
19,000	.0159	....	
20,000	.0180	.0050	
21,000	.0200	....	
22,000	.0225	....	
23,000	.0254	.0100	
32,400	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7920.

Chassis, right hand.
Marks, 9–2E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0003	....	
3,000	.0009	....	
4,000	.0015	....	
5,000	.0020	....	
6,000	.0027	....	
7,000	.0032	....	
8,000	.0040	....	
9,000	.0048	....	
10,000	.0053	0.	
11,000	.0062	....	
12,000	.0070	....	
13,000	.0080	....	
14,000	.0090	....	
15,000	.0101	.0012	
16,000	.0115	....	
17,000	.0130	....	
18,000	.0148	....	
19,000	.0167	....	
20,000	.0188	.0057	
21,000	.0215	....	
22,000	.0248	....	
23,000	.0282	.0119	
29,800	....	....	Tensile strength.

Fractured ″.40 from the neck.
Appearance of fracture, granular, gray.

No. 7921.

Racer.
Marks, 10–1E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0011	....	
4,000	.0017	....	
5,000	.0022	....	
6,000	.0030	....	
7,000	.0036	....	
8,000	.0042	....	
9,000	.0050	....	
10,000	.0058	.0002	
11,000	.0065	....	
12,000	.0075	....	
13,000	.0084	....	
14,000	.0095	....	
15,000	.0105	.0015	
16,000	.0120	....	
17 000	.0133	....	
18,000	.0150	....	
19,000	.0168	....	
20,000	.0190	.0059	
21,000	.0220	....	
22,000	.0250	....	
23,000	.0285	.0121	
25,700	....	....	Tensile strength.

Fractured 3″ from the neck.
Appearance of fracture, granular, gray.

No. 7924.

Racer.
Marks, 12–1E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	....	
3,000	.0012	....	
4,000	.0019	....	
5,000	.0025	....	
6,000	.0030	....	
7,000	.0038	....	
8,000	.0045	....	
9,000	.0052	....	
10,000	.0059	.0003	
11,000	.0068	....	
12,000	.0077	....	
13,000	.0087	....	
14,000	.0097	....	
15,000	.0108	.0016	
16,000	.0119	....	
17,000	.0130	....	
18,000	.0145	....	
19,000	.0160	....	
20,000	.0179	.0048	
21,000	.0200	....	
22,000	.0226	....	
23,000	.0255	....	
31,900	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7925.

Chassis, right hand.
Marks, 13–1E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	....	
3,000	.0012	....	
4,000	.0018	....	
5,000	.0023	....	
6,000	.0029	....	
7,000	.0036	....	
8,000	.0041	....	
9,000	.0049	....	
10,000	.0057	.0001	
11,000	.0063	....	
12,000	.0070	....	
13,000	.0079	....	
14,000	.0088	....	
15,000	.0097	.0009	
16,000	.0107	....	
17,000	.0118	....	
18,000	.0130	....	
19,000	.0142	....	
20,000	.0160	.0033	
21,000	.0178	....	
22,000	.0198	....	
23,000	.0220	....	
24,000	.0245	....	
25,000	.0280	....	
31,000	....	....	Tensile strength.

Fractured 4″.25 from the neck.
Appearance of fracture, granular, gray.

No. 7926.

Top carriage.
Marks, 13–2E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0011	....	
4,000	.0017	....	
5,000	.0022	....	
6,000	.0029	....	
7,000	.0036	....	
8,000	.0041	....	
9,000	.0048	....	
10,000	.0056	0.	
11,000	.0063	....	
12,000	.0071	....	
13,000	.0080	....	
14,000	.0090	....	
15,000	.0099	.0010	
16,000	.0109	....	
17,000	.0120	....	
18,000	.0133	....	
19,000	.0148	....	
20,000	.0163	.0037	
21,000	.0180	....	
22,000	.0203	....	
23,000	.0225	....	
24,000	.0255	....	
32,500	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7927.

Racer.
Marks, 14–1E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	....	
3,000	.0016	....	
4,000	.0021	....	
5,000	.0028	....	
6,000	.0036	....	
7,000	.0041	....	
8,000	.0050	....	
9,000	.0058	....	
10,000	.0067	.0007	
11,000	.0075	....	
12,000	.0086	....	
13,000	.0096	....	
14,000	.0107	....	
15,000	.0119	.0023	
16,000	.0132	....	
17,000	.0148	....	
18,000	.0169	....	
19,000	.0190	....	
20,000	.0211	.0071	
21,000	.0240	....	
22,000	.0270	....	
29,900	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7928.

Chassis, right hand.
Marks, 14–2E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	....	
3,000	.0013	....	
4,000	.0019	....	
5,000	.0024	....	
6,000	.0031	....	
7,000	.0039	....	
8,000	.0045	....	
9,000	.0052	....	
10,000	.0060	.0003	
11,000	.0069	....	
12,000	.0078	....	
13,000	.0088	....	
14,000	.0098	....	
15,000	.0108	.0018	
16,000	.0121	....	
17,000	.0137	....	
18,000	.0152	....	
19,000	.0173	....	
20,000	.0198	.0060	
21,000	.0220	....	
22,000	.0250	....	
31,800	....	....	Tensile strength.

Fractured 1″.35 from the neck.
Appearance of fracture, granular, gray.

No. 7941.

Chassis, right hand.
Marks, 15–1E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	....	
3,000	.0013	....	
4,000	.0020	....	
5,000	.0027	....	
6,000	.0033	....	
7,000	.0040	....	
8,000	.0049	....	
9,000	.0058	....	
10,000	.0066	.0003	
11,000	.0075	....	
12,000	.0083	....	
13,000	.0093	....	
14,000	.0105	....	
15,000	.0117	.0017	
16,000	.0130	....	
17,000	.0147	....	
18,000	.0162	....	
19,000	.0192	....	
20,000	.0210	.0060	
21,000	.0238	....	
22,000	.0265	....	
30,100	....	....	Tensile strength.

Fractured 4″ from the neck.
Appearance of fracture, granular, gray.

No. 7980.

Racer.
Marks, 55–E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	....	
3,000	.0007	....	
4,000	.0010	....	
5,000	.0014	....	
6,000	.0018	....	
7,000	.0022	....	
8,000	.0027	....	
9,000	.0030	....	
10,000	.0034	....	
11,000	.0039	....	
12,000	.0044	....	
13,000	.0054	....	
14,000	.0057	....	
15,000	.0063	....	
16,000	.0069	....	
17,000	.0079	....	
18,000	.0087	....	
19,000	.0099	....	
20,000	.0110	....	
21,000	.0125	....	
26,200	.0250	....	=0.42 per cent elongation in 6″.
29,600	....	....	Tensile strength.

Fractured 1″.75 from the neck.
Appearance of fracture, granular.

No. 7981.

Racer.
Marks, 56–E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0003		
3,000	.0006		
4,000	.0010		
5,000	.0014		
6,000	.0017		
7,000	.0021		
8,000	.0026		
9,000	.0029		
10,000	.0033		
11,000	.0038		
12,000	.0043		
13,000	.0048		
14,000	.0054		
15,000	.0059		
16,000	.0067		
17,000	.0074		
18,000	.0082		
19,000	.0091		
20,000	.0102		
21,000	.0115		
22,000	.0128		
23,000	.0145		
24,000	.0165		=0.27 per cent elongation in 6″.
31,200			Tensile strength.

Fractured at the neck.
Appearance of fracture, granular.

No. 7982.

Top carriage.
Marks, 57-E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0003	....	
3,000	.0006	....	
4,000	.0010	....	
5,000	.0014	....	
6,000	.0017	....	
7,000	.0022	....	
8,000	.0027	....	
9,000	.0031	....	
10,000	.0035	....	
11,000	.0041	....	
12,000	.0047	....	
13,000	.0052	....	
14,000	.0059	....	
15,000	.0065	....	
16,000	.0074	....	
17,000	.0083	....	
18,000	.0094	....	
19,000	.0105	....	
20,000	.0117	....	
21,000	.0133	....	
22,000	.0152	....	=0.25 per cent elongation in 6″.
27,900	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular.

No. 7985.

Racer.
Marks, 58-E.
Diameter, 1".129.
Sectional area, 1 square inch.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	....	
3,000	.0011	....	
4,000	.0019	....	
5,000	.0028	....	
6,000	.0032	....	
7,000	.0039	....	
8,000	.0048	....	
9,000	.0052	....	
10,000	.0061	....	
11,000	.0070	....	
12,000	.0079	....	
13,000	.0088	....	
14,000	.0096	....	
15,000	.0108	....	
16,000	.0118	....	
17,000	.0133	....	
18,000	.0150	....	
19,000	.0166	....	
20,000	.0188	....	
21,000	.0215	....	
22,000	.0239	....	
23,000	.0276	....	
31,200	....	....	Tensile strength.

Fractured 3".5 from the neck.
Appearance of fracture, gray, granular.

No. 7986.

R. H. chassis and top carriage.
Marks, 59-E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	....	
3,000	.0012	....	
4,000	.0020	....	
5,000	.0027	....	
6,000	.0033	....	
7,000	.0040	....	
8,000	.0049	....	
9,000	.0056	....	
10,000	.0066	....	
11,000	.0072	....	
12,000	.0081	....	
13,000	.0092	....	
14,000	.0104	....	
15,000	.0115	....	
16,000	.0130	....	
17,000	.0144	....	
18,000	.0158	....	
19,000	.0176	....	
20,000	.0200	....	
21,000	.0230	....	
22,000	.0256	....	
29,600	....	....	Tensile strength.

Fractured 1″.5 from the neck.
Appearance of fracture, granular, gray.

No. 7990.

Base ring.
Marks, 60-E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0013	....	
4,000	.0019	....	
5,000	.0025	....	
6,000	.0031	....	
7,000	.0039	....	
8,000	.0043	....	
9,000	.0051	....	
10,000	.0059	....	
11,000	.0067	....	
12,000	.0072	....	
13,000	.0081	....	
14,000	.0093	....	
15,000	.0102	....	
16,000	.0117	....	
17,000	.0130	....	
18,000	.0146	....	
19,000	.0162	....	
20,000	.0181	....	
21,000	.0200	....	
22,000	.0232	....	
23,000	.0260	....	
31,100	....	....	Tensile strength.

Fractured 2″ from the neck.
Appearance of fracture, granular, gray.

No. 7991.

Top carriage.
Marks, 61-E.
Diameter, 1".129.
Sectional area, 1 square inch.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0012	....	
4,000	.0019	....	
5,000	.0023	....	
6,000	.0030	....	
7,000	.0038	....	
8,000	.0043	....	
9,000	.0050	....	
10,000	.0059	....	
11,000	.0068	....	
12,000	.0074	....	
13,000	.0083	....	
14,000	.0093	....	
15,000	.0103	....	
16,000	.0116	....	
17,000	.0129	....	
18,000	.0143	....	
19,000	.0159	....	
20,000	.0182	....	
21,000	.0202	....	
22,000	.0230	....	
23,000	.0265	....	
26,200	....	....	Tensile strength.

Fractured 4" from the neck.
Appearance of fracture, granular, gray.

No. 7992.

Base ring.
Marks, 62–E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0012	....	
4,000	.0017	....	
5,000	.0025	....	
6,000	.0032	....	
7,000	.0040	....	
8,000	.0049	....	
9,000	.0058	....	
10,000	.0065	....	
11,000	.0073	....	
12,000	.0084	....	
13,000	.0097	....	
14,000	.0109	....	
15,000	.0122	....	
16,000	.0137	....	
17,000	.0158	....	
18,000	.0178	....	
19,000	.0204	....	
20,000	.0237	....	
21,000	.0270	....	
30,000	....	....	Tensile strength.

Fractured at the middle of the stem.
Appearance of fracture, granular, gray.

No. 7996.

L. H. chassis.
Marks, 63–E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	....	
3,000	.0012	....	
4,000	.0020	....	
5,000	.0027	....	
6,000	.0033	....	
7,000	.0040	....	
8,000	.0050	....	
9,000	.0055	....	
10,000	.0063	....	
11,000	.0072	....	
12,000	.0081	....	
13,000	.0094	....	
14,000	.0105	....	
15,000	.0117	....	
16,000	.0131	....	
17,000	.0146	....	
18,000	.0162	....	
19,000	.0185	....	
20,000	.0210	....	
21,000	.0238	....	
22,000	.0270	....	
23,700	....	....	Tensile strength.

Fractured 3″ from the neck.
Appearance of fracture, granular, gray.

No. 8002.

L. H. chassis.
Marks, 64–E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004		
3,000	.0010		
4,000	.0016		
5,000	.0021		
6,000	.0027		
7,000	.0030		
8,000	.0040		
9,000	.0048		
10,000	.0053		
11,000	.0061		
12,000	.0069		
13,000	.0077		
14,000	.0086		
15,000	.0095		
16,000	.0104		
17,000	.0116		
18,000	.0129		
19,000	.0142		
20,000	.0159		
21,000	.0174		
22,000	.0198		
23,000	.0223		
24,000	.0250		
31,200			Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, light gray.

CAST IRON FROM BUILDERS IRON FOUNDRY.

No. 7772.

Marks, 2.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	....	
3,000	.0014	....	
4,000	.0019	....	
5,000	.0026	.0002	
6,000	.0032	....	
7,000	.0037	....	
8,000	.0043	....	
9,000	.0049	....	
10,000	.0056	.0005	
11,000	.0063	....	
12,000	.0070	....	
13,000	.0076	....	
14,000	.0084	....	
15,000	.0090	.0013	
16,000	.0101	....	
17,000	.0110	....	
18,000	.0120	....	
19,000	.0129	....	
20,000	.0140	.0029	
21,000	.0151	....	
22,000	.0164	....	
23,000	.0177	....	
24,000	.0197	....	
25,000	.0215	.0068	
26,000	.0240	....	
27,000	.0263	.0098	
33,300	....	....	Tensile strength.

Fractured 1″.25 from the neck.
Appearance of fracture, fine granular, granitic.

CAST IRON FROM WATERTOWN ARSENAL FOUNDRY.

No. 7917.

Base ring for 12-inch disappearing carriage.
Marks, 168.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	....	
3,000	.0013	....	
4,000	.0020	....	
5,000	.0026	....	
6,000	.0033	....	
7,000	.0040	....	
8,000	.0047	....	
9,000	.0056	....	
10,000	.0064	.0005	
11,000	.0073	....	
12,000	.0080	....	
13,000	.0091	....	
14,000	.0102	....	
15,000	.0112	.0016	
16,000	.0125	....	
17,000	.0140	....	
18,000	.0156	....	
19,000	.0172	....	
20,000	.0193	.0050	
21,000	.0220	....	
22,000	.0246	....	
23,000	.0280	.0111	
26,800	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7952.

Racer and base ring for 6-inch disappearing carriage; base ring for 10-inch disappearing carriage.

Marks, No. 179.

Diameter, 1".129.

Sectional area, 1 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	....	
3,000	.0013	....	
4,000	.0021	....	
5,000	.0028	....	
6,000	.0035	....	
7,000	.0043	....	
8,000	.0052	....	
9,000	.0062	....	
10,000	.0073	....	
11,000	.0082	....	
12,000	.0096	....	
13,000	.0109	....	
14,000	.0122	....	
15,000	.0138	....	
16,000	.0157	....	
17,000	.0180	....	
18,000	.0205	....	
19,000	.0230	....	
20,000	.0268	....	
23,300	....	....	Tensile strength.

Fractured at the neck.

Appearance of fracture, granular, gray.

No. 7958.

Chassis for 6-inch disappearing carriage.
Marks, R R 53.
Diameter, 1".129.
Sectional area, 1 square inch.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0005	....	
3,000	.0011	....	
4,000	.0020	....	
5,000	.0025	....	
6,000	.0031	....	
7,000	.0039	....	
8,000	.0048	....	
9,000	.0054	....	
10,000	.0062	....	
11,000	.0070	....	
12,000	.0079	....	
13,000	.0090	....	
14,000	.0100	....	
15,000	.0111	....	
16,000	.0124	....	
17,000	.0140	....	
18,000	.0152	....	
19,000	.0173	....	
20,000	.0195	....	
21,000	.0228	....	
22,000	.0259	....	
29,320	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7961.

Base ring and racer for 6-inch disappearing carriage.
Marks, No. 183.
Diameter, 1".129.
Sectional area, 1 square inch.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	....	
3,000	.0009	....	
4,000	.0015	....	
5,000	.0021	....	
6,000	.0027	....	
7,000	.0034	....	
8,000	.0040	....	
9,000	.0046	....	
10,600	.0053	.0002	
11,000	.0060	....	
12,000	.0068	....	
13,000	.0075	....	
14,000	.0084	....	
15,000	.0093	.0007	
16,000	.0101	....	
17,000	.0110	....	
18,000	.0122	....	
19,000	.0133	....	
20,000	.0148	....	
21,000	.0163	....	
22,000	.0180	....	
23,000	.0198	....	
24,000	.0215	....	
25,000	.0239	....	
26,000	.0265	....	
31,600	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 7989.

Twelve-inch dummy projectiles.
Marks, E–1.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	....	
3,000	.0015	....	
4,000	.0023	....	
5,000	.0031	....	
6,000	.0041	....	
7,000	.0052	....	
8,000	.0063	....	
9,000	.0075	....	
10,000	.0089	.0018	
11,000	.0106	....	
12,000	.0129	....	
13,000	.0153	....	
14,000	.0185	....	
15,000	.0226	.0097	
16,000	.0270	....	
17,000	.0332	.0180	
21,900	....	....	Tensile strength.

Fractured at the neck.
Appearance of fracture, medium granular, dark gray, bright facets.

CAST AND PIG IRONS, CHEMICAL ANALYSES.

FROM WATERTOWN ARSENAL FOUNDRY.

Description.	Carbon.			Manganese.	Silicon.	Sulphur.	Phosphorus.	Remarks.
	Total.	Graphitic.	Combined.					
Heat 164				1.100	1.980			
Heat 173					1.41	.110	.600	
Heat 175					1.65	.075		
Heat 175					1.50	.067		
Heat 175					1.50	.073		

PIG IRONS.

Description.	Carbon. Total.	Carbon. Graphitic.	Carbon. Combined.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Remarks.
No. 1	3.840			.620	3.37	.016	.035	For arsenal steel plant.
No. 2	3.760			.730	2.50	.018		Do.
No. 3	3.700			.540	3.68	.016		Do.
No. 4	3.760			.520	2.72	.016		Do.
No. 5	3.800			.550	3.76	.017		Do.
No. 6	3.680			.660	2.50	.018		Do.
No. 7	3.730			.550	2.98	.017		Do.
No. 8	3.710			.660	2.82	.017		Do.
Salisbury carbonate				.320	1.84	.115	.655	
Muirkirk				1.120	2.17	.068	.626	
American				1.010	5.00	.035	.887	
Salisbury				1.01	1.40	.017	.381	
No. 866	3.950				2.300	.014	.040	Do.
No. 1602	3.990				2.100	.024	.039	Do.
No. 37500	3.940				2.080	.019	.030	Do.
No. 14417					2.000	.025	.030	Do.
No. 14162	3.420				1.250	.023	.026	Do.
No. 20941					3.250	.018	.646	
No. 1998					2.180	.016	.028	Do.
No. 14162-2					.950	.020	.028	Do.
No. 2671					2.270	.014		Do.
No. 14417				.98	3.00	.020	.032	Do.

BRONZE.

No. 7758.

Tobin bronze, recast at Watertown Arsenal foundry.
Marks, No. 4, AA–135.
Diameter, 1″.009.
Sectional area, .80 square inch.
Gauged length, 8″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0023	....	
10,000	.0052	0.	
11,000	.0059	....	
12,000	.0066	....	
13,000	.0072	....	
14,000	.0083	....	
15,000	.0093	.0010	Elastic limit. Approximate.
16,000	.0108	....	
17,000	.0127	....	
18,000	.0150	....	
19,000	.0180	....	
20,000	.0216	.0089	
21,000	.0253	....	
22,000	.0311	....	
23,000	.0372	....	
24,000	.0458	....	
25,000	.0558	.0379	
26,000	.0660	....	
27,000	.0818	....	
28,000	.0985	....	
29,000	.1183	....	
30,000	.1410	.1178	
31,000	.17	....	
32,000	.20	....	
33,000	.23	....	
34,000	.26	....	
35,000	.30	....	
36,000	.34	....	
38,000	.41	....	
40,000	.50	....	
42,000	.60	....	
44,000	.71	....	
44,750	....	....	Tensile strength.
0	.76	....	=9.5 per cent.

Elongation of inch sections, ″.07, ″.08, ″.08, ″.08, ″.08, ″.09, ″.19*, ″.09.
Diameter at fracture, ″.92; area, .665 square inch.
Contraction of area, 16.9 per cent.
Fractured 1″.64 from the neck.
Appearance of fracture, light lavender yellow, with spots of lemon-yellow metal.

REMARKS.—The approximate elastic limits entered in the following tests of bronze state the loads per square inch below which the permanent deformations of the metal were not of a pronounced extent. Early sets are generally developed in the tests of this metal.

BRONZE.

FROM WATERTOWN ARSENAL FOUNDRY.

Description.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″	
75-millimeter mountain gun carriage	23,000	36,500	9.5	13.2	.09, .10*	Light yellow; dark spot.
Do	18,000	40,500	17.0	16.9	.15	Light yellow.
Do	21,500	38,050	12.0	13.2	.10, .14*	Dark yellow.
6-pounder gun mount	35,500	68,500	16.5	16.9	.14, .19*	Light and lemon yellow.
Do	32,000	71,000	21.5	20.5	.23*, .20	Light yellow; oblique.
Do	31,000	66,500	14.0	16.9	.15*, .13	Light yellow.
Do	32,000	53,000	7.0	13.2	.05, .09	Lavender and lemon yellow.
Do	32,000	73,000	29.0	27.4	.31*, .27	Uniform light yellow.
6-inch barbette carriage	26,500	55,500	14.0	16.9	.12, .16*	Light yellow and lavender.
Do	29,200	60,800	18.0	21.4	.18	Uniform light yellow.
Do	18,600	52,400	51.0	57.6	.37, .57, .59	Light yellow; silky.
Do	54,000	66,960	30.0	47.2	.15, .45*	Do.
Do	51,600	63,600	31.5	52.4	.48,* .15	Do.
Do	50,500	63,400	24.5	46.2	.12, .37*	Uniform light yellow.
Do	43,650	53,550	5.5	27.4	.09*, .02	Do.
Do	42,500	67,050	30.5	54.6	.44*, .17	Do.
Do	41,500	58,200	28.5	40.3	.17, .40*	Do.
Do	23,900	50,850	11.5	16.9	.12*, .11	Lavender and yellow.
Do	33,600	60,600	38.5	59.2	.29, .37, .58*, .30	Fine silky; uniform light yellow.
Do	43,000	60,200	29.5	37.1	.38*, .21	Do.
Do	25,500	67,700	28.0	30.7	.30, .36*	Light yellow.
Do	27,800	57,600	47.5	49.0	.44, .51*	Fine silky; uniform light yellow.
Do	40,800	62,040	42.0	52.4	.30, .54	Light yellow; silky.
Do	40,600	60,400	34.5	33.6	.31, .38*	Do.
Do	41,000	60,200	21.5	23.0	.20, .23*	Light yellow; pipe at center.
Do	28,200	56,800	48.0	59.2	.65*, .31	Fine silky; uniform light yellow.
Do	38,000	61,160	27.0	30.6	.30*, .24	Fine silky; uniform light yellow; pipe at center.
Do	42,000	60,940	34.0	37.6	.38*, .30*	Fine silky; uniform light yellow.

Do.	35,760	59,900	42.0	57.6	.25, .59*	Do.
Do.	35,200	56,560	27.0	29.4	.32*, .22	Do.
Do.	34,400	58,400	44.5	52.4	.45*, .44*	Do.
6-inch disappearing carriage	24,950	60,800	26.5	27.4	.26, .27*	Uniform light yellow.
Do.	21,500	36,400	5.0	9.5	.02, .08*	Lavender and lemon yellow.
Do.	22,000	53,500	12.0	20.5	.11, .13	Light yellow; small defective spot.
Do.	21,500	45,000	13.5	13.2	.10, .17*	Light and lemon yellow.
Do.	22,500	56,000	23.5	23.9	.25*, .22	Light yellow; oblique.
Do.	23,000	46,500	9.5	13.2	.06, .13*	Lavender and lemon yellow.
Do.	31,500	54,000	6.5	13.2	.06, .07*	Lavender and light yellow.
Do.	17,000	17,000	1.5	....	.03, .00	Dark brown; spongy.
Do.	32,500	68,500	19.0	20.5	.21*, .17	Light yellow.
Do.	22,000	58,000	30.0	30.7	.26, .34*	Light yellow; oblique.
Do.	30,000	75,500	31.0	37.1	.26, .36*	Light yellow; silky.
Do.	27,000	66,500	22.0	20.5	.20, .24*	Light yellow.
Do.	33,000	70,000	19.0	20.5	.16, .22*	Do.
Do.	32,500	74,000	22.0	23.9	.25*, .19	Do.
Do.	25,500	64,000	31.0	30.7	.27, .35*	Do.
Do.	26,000	57,000	18.5	20.5	.15, .22*	Light and lemon yellow.
Do.	26,500	61,000	23.5	20.5	.25*, .22	Do.
Do.	23,000	44,000	5.5	9.5	.05, .06	Light yellow; dark spot. Broke in neck.
Do.	20,500	61,000	23.0	27.4	.24*, .22	Light yellow.
Do.	20,500	60,500	36.0	37.1	.35, .37*	Do.
Do.	23,500	51,000	12.5	16.9	.10, .15*	Light and lemon yellow.
Do.	28,000	75,000	33.5	30.7	.39*, .28	Light yellow; oblique.
8-inch disappearing carriage	31,000	70,100	24.5	27.4	.23, .26*	Light yellow.
Do.	34,000	73,000	22.5	20.5	.22, .23*	Do.
10-inch disappearing carriage	24,800	63,200	16.7	24.6	.19*, .17, .14	Light yellow; oblique.
Do.	26,500	68,500	30.0	30.7	.27, .33*	Do.
Do.	28,000	71,000	32.0	30.7	.36*, .28	Light yellow.
Do.	27,000	70,100	31.5	30.7	.34*, .29	Do.
Do.	19,600	48,960	11.7	15.0	.15*, .10, .10	Light yellow and lavender.
Do.	17,600	22,600	2.7	5.0	.01, .00, .07*	Lemon yellow, 60 per cent; lavender, 40 per cent.
Do.	16,800	39,440	6.7	15.0	.11*, .04, .05	Lemon yellow and lavender.
Do.	17,200	32,080	5.3	18.3	.02, .12*, .02	Lavender; light green spot.
Do.	25,600	52,800	9.7	18.3	.16*, .06, .07	Light yellow; light green spot.
Do.	24,800	54,000	9.3	15.0	.07, .06, .15*	Light lavender; lemon yellow spot.
Do.	24,800	54,400	10.0	18.3	.15*, .07, .08	Light yellow and lavender.
Do.	28,400	50,400	7.3	18.3	.05, .10, .12*	Do.
Do.	22,000	47,840	6.7	11.8	.05, .05, .10*	Light yellow and lemon.
Do.	14,400	27,200	4.0	8.4	.03, .08*, .01	Lemon yellow; spongy.
Do.	18,400	31,200	4.0	11.8	.02, .02, .08*	Greenish yellow.
Do.	28,000	61,000	24.0	20.5	.24*	Light yellow; oblique.
Do.	26,400	68,240	27.0	27.6	.31*, .26, .24	Do.
Do.	23,600	68,080	25.0	24.6	.30*, .22, .23	Do.
Do.	26,800	41,440	6.0	11.8	.07, .06, .05*	Light yellow; irregular.
Do.	24,800	46,800	6.7	15.0	.05, .07, .08*	Do.
Do.	22,400	37,920	5.3	11.8	.05, .06, .05*	Do.
Do.	18,800	41,200	7.4	8.4	.08*, .08*, .06	Do.

Bronze—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

Description.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
10-inch disappearing carriage	42,600	67,600	12.3	16.2	.10, .13, .14*	Uniform light yellow.
Do	38,600	43,880	3.3	6.8	.02, .01, .07*	Lavender; lemon yellow center.
Do	....	25,160	0.7	....	.00, .00, .02	Broke at neck. Lemon yellow; oblique.
Do	35,400	42,000	3.0	4.4	.01, .03, .05*	Lavender and lemon yellow.
Do	32,400	73,000	23.3	23.0	.26*, .23, .21	Uniform light yellow.
Do	33,600	73,800	28.7	27.4	.28, .34*, .24	Do.
Do	33,600	73,600	29.0	27.4	.24, .31*, .32*	Do.
Do	35,200	73,000	24.3	23.0	.21, .30*, .22	Do.
Do	36,200	69,200	18.0	20.8	.16, .23*, .15	Uniform light yellow; oblique.
Do	35,400	71,540	20.3	23.0	.18, .20, .23*	Uniform light yellow.
Do	33,400	74,200	29.0	25.2	.32*, .29, .26	Do.
Do	35,200	71,600	21.7	23.0	.20, .21, .24*	Do.
Do	28,000	62,400	15.0	18.3	.14, .16*	Do.
Do	30,800	63,560	15.5	21.4	.13, .18*	Do.
Do	26,400	50,760	10.7	18.3	.15*, .09, .08	Light yellow; lemon yellow spots.
Do	25,600	66,800	19.7	23.0	.15, .23*, .21	Uniform light yellow.
Do	32,400	66,800	18.3	20.8	.15, .20*, .20*	Do.
Do	31,200	70,200	25.0	23.0	.28*, .25, .22	Do.
Do	30,400	59,600	12.3	14.0	.09, .19*, .09	Uniform light yellow. Opened cracks in stem.
Do	35,600	73,000	27.3	29.4	.23, .27, .32*	Uniform light yellow.
Do	34,600	69,600	17.3	20.8	.16, .21*, .15	Do.
Do	34,800	73,400	25.3	25.2	.29*, .25, .22	Do.
Do	33,000	72,600	24.0	27.4	.28*, .23, .21	Do.
Do	32,400	72,200	26.3	27.4	.25, .30*, .24	Do.
Do	32,200	61,600	11.3	18.6	.08, .10, .16*	Do.
Do	29,600	31,600	2.7	9.2	.00, .06*, .02	Greenish yellow; spongy.
Do	22,400	47,600	12.5	18.3	.15*, .10	Light yellow; irregular.
Do	26,000	64,400	16.7	24.6	.15, .15, .20*	Uniform light lavender.
Do	21,600	60,600	12.0	18.3	.10, .16*, .10	Do.
Do	50,470	66,140	38.0	44.5	.48*, .28	Uniform light yellow; oblique.
Do	34,200	70,100	22.7	23.0	.26*, .21, .21	Uniform light yellow.
Do	35,200	66,200	14.3	20.8	.15, .14, .14	Light yellow; lemon yellow spots.
Do	31,800	63,200	13.7	18.6	.12, .19*, .10	Light yellow.
Do	27,600	63,600	15.0	21.4	.18*, .14, .13	Do.
Do	29,800	71,200	28.3	29.4	.23, .37*, .25	Uniform light yellow.
Do	31,600	69,000	21.0	23.0	.19, .20, .24*	Do.

Do	33,600	41,200	3.8	11.6	.01, .02, .07*	Lavender and lemon yellow.
Do	31,400	68,200	19.7	20.8	.24*, .18, .17	Uniform light yellow; oblique.
Do	28,400	70,600	24.7	25.2	.23, .25, .26*	Uniform light yellow.
Do	34,400	49,600	3.3	16.2	.03, .03, .04	Light yellow; blowhole.
Do	35,200	65,200	10.0	20.8	.09, .10, .11	Do.
Do	29,000	54,400	9.3	11.6	.06, .14*, .08	Light lemon yellow; oblique.
Do	25,600	40,100	3.7	9.2	.01, .08*, .02	Light lemon yellow; irregular.
Do	33,100	72,650	23.5	19.5	.27*, .20	Uniform light yellow; oblique.
Do	24,780	73,810	29.0	33.6	.31*, .27	Do.
Do	36,400	71,800	20.5	23.0	.32*, .19	Light yellow; lemon yellow spots.
Do	40,370	60,850	53.5	47.3	.50, .57*	Uniform light yellow.
Do	55,560	68,280	42.5	40.7	.54*, .31	Do.
Do	29,000	75,500	27.5	30.7	.28*, .27	Do.
Do	31,000	75,600	35.5	37,1	.38*, .33	Do.
Do	31,500	72,900	21.0	27.4	.20, .22*	Do.
Do	34,000	75,300	32.5	30.7	.28*, .37	Do.
Do	32,500	76,000	36.5	43.3	.40*, .33	Do.
Do	28,000	74,900	26.0	27.4	.24, .28*	Do.
Do	31,000	76,000	27.5	34.0	.31*, .24	Do.
Do	33,500	75,500	30.0	34.0	.26, .34*	Do.
Do	29,000	71,500	20.5	23.9	.19, .22*	Do.
Do	28,500	71,000	32.0	37.1	.25, .39*	Do.
Do	19,500	49,400	15.0	23.9	.16*, .14	Light yellow.
Do	20,000	49,100	14.0	20.5	.16*, .12	Do.
Do	19,500	50,500	15.0	27.4	.17*, .13	Do.
Do	22,000	51,600	14.0	16.9	.15*, .13	Do.
Do	21,000	48,000	11.5	16.9	.15*, .08	Do.
Do	20,000	53,750	22.0	23.9	.18, .26*	Do.
Do	19,000	34,000	6.5	9.5	.03, .10*	Lemon yellow.
Do	20,500	42,500	9.5	13.2	.11*, .08	Do.
Do	19,500	39,500	8.5	13.2	.11*, .06	Do.
Do	21,000	48,600	12.5	16.9	.14*, .11	Light yellow.
Do	30.500	73,900	33.0	34.0	.26, .40*	Uniform light yellow.
Do	31,000	75,300	33.0	37.1	.37*, .29	Do.
Do	29,500	68,750	17.5	23.9	.19*, .16	Do.
Do	32,500	74,900	25.5	27.4	.28*, .23	Do.
Do	34,000	75,200	25.5	27.4	.29, .22	Do.
Do	32,000	73,700	36.0	40.3	.37*, .33*	Do.
Do	40,420	61,660	31.5	31.3	.28, .35*	Uniform light yellow; oblique; silvery spot.
Do	33,000	76,500	28.5	30.7	.32*, .25	Uniform light yellow.
Do	32,500	75,200	26.0	27.4	.28*, .24	Do.
Do	23,000	50,100	17.0	20.5	.19*, .15	Lavender and yellow.
Do	18,500	46,750	13.5	20.5	.17*, .10	Do.
Do	21,000	59,000	22.0	27.4	.24*, .20	Light yellow.
Do	30,900	73,500	31.5	34.0	.26, .37*	Uniform light yellow.
Do	31,500	73,200	26.5	23.9	.24, .29*	Do.
Do	29,500	72,500	25.0	23.9	.22, .28*	Do.
Do	31,000	73,400	23.0	27.4	.25*, .21	Do.
Do	32,500	76,000	35.0	34.0	.30, .40*	Do.
Do	29,900	73,000	26.0	23.9	.28*, .24	Do.
Do	31,000	70,500	19.5	27.4	.22*, .17	Light yellow.
Do	31,500	72,500	27.5	27.4	.29*, .26	Do.

Bronze—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

Description.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
10-inch disappearing carriage	30,500	72,000	25.5	27.4	.23, .28*	Light yellow.
Do	26,000	64,500	15.5	34.0	.13, .18*	Lavender and light yellow.
Do	28,000	60,000	11.5	37.1	.14*, .09	Do.
Do	24,000	50,500	15.0	20.5	.15, .15	Light and lemon yellow.
Do	35,500	71,500	22.5	23.9	.24*, .21	Light yellow.
Do	34,500	71,500	24.0	23.9	.25*, .23	Do.
Do	32,500	57,600	9.0	20.5	.10*, .08	Light and lemon yellow.
Do	31,000	39,500	4.0	13.2	.01, .07*	Lavender and lemon yellow.
Do	30,500	56,000	7.5	13.2	.10*, .05	Do.
Do	31,500	38,000	4.0	9.5	.01, .07*	Dark brown and yellow.
Do	32,500	72,000	22.5	27.4	.20, .25*	Light yellow.
Do	34,500	59,800	8.0	20.5	.10, .06	Light and lemon yellow.
Do	33,000	72,500	24.0	23.9	.26*, .22	Light yellow.
Do	32,000	72,000	26.5	27.4	.26, .27*	Do.
Do	33,000	69,050	20.0	27.4	.23*, .17	Do.
Do	36,000	73,000	28.0	30.7	.32*, .24	Do.
Do	33,500	59,500	10.5	20.5	.08, .13*	Light and lemon yellow.
Do	45,360	61,800	38.2	49.6	.32, .38, .38, .67, .38, .34, .32, .27	Silky; oblique.
Do	44,800	62,400	34.9	49.3	.26, .33, .60, .40, .34, .32, .30, .24	Do.
Do	31,500	73,000	29.0	30.7	.31*, .27	Light yellow.
Do	69,820	77,480	16.5	23.4	.24*, .09	Do.
Do	31,000	69,500	20.0	23.9	.22*, .18	Do.
Do	30,500	71,500	20.5	23.9	.18, .23*	Do.
Do	29,000	71,000	28.5	27.4	.31*, .26	Do.
Do	30,500	68,000	29.0	34.0	.25, .33*	Light yellow; silky.
Do	26,000	58,000	23.0	27.4	.25*, .21	Light and lemon yellow.
Do	31,600	55,000	46.5	52.0	.55*, .38	Light yellow; fine silky.
Do	24,500	51,500	13.0	20.5	.10, .16*	Light yellow; dark brown spot
Do	31,000	75,000	28.5	37.1	.36*, .21	Light yellow.
Do	32,000	74,500	31.0	40.3	.25, .37*	Do.
Do	31,000	75,500	30.0	34.0	.37*, .23	Do.

10-inch barbette carriage	23,000	49,500	14.0	20.5	.16*, .12	Light and lemon yellow.
12-inch disappearing carriage	13,000	40,080	5.7	15.0	.04, .09*, .04	Light yellow and lavender.
Do	21,600	66,800	24.3	27.6	.28*, .24, .21	Dark lavender.
Do	28,400	54,800	14.5	16.2	.18*, .11	Light yellow; irregular
Do	29,000	67,000	13.0	13.2	.14, .12	Light yellow.
Do	31,500	65,100	12.5	20.5	.11, .14*	Lavender; lemon yellow spots.
Do	32,800	73,800	19.0	23.0	.16, .22*	Do.
Do	37,000	73,000	15.5	20.8	.13, .18*	Light yellow.
Do	39,500	78,200	25.0	27.4	.25*, .25	Uniform light yellow.
Do	39,500	78,600	25.0	30.7	.27*, .23	Do.
Do	34,000	77,300	28.0	34.0	.24, .32*	Do.
Do	31,000	74,000	32.0	30.7	.35*, .29	Do.
Do	35,500	76,800	27.5	30.7	.31*, .24	Do.
Do	37,000	75,500	28.5	27.4	.33*, .24	Do.
Do	37,400	80,600	26.0	30.7	.24, .28*	Do.
Do	36,900	79,000	30.5	34.0	.36*, .25	Do.
Do	36,900	78,500	25.0	27.4	.28*, .22	Do.
Do	32,000	74,850	33.0	37.1	.26, .40*	Do.
Do	29,100	74,850	31.0	37.1	.25, .37*	Do.
Do	34,300	76,400	33.0	37.1	.25, .31*	Do.
Do	32,000	75,500	34.5	37.1	.27, .42*	Do.
Do	31,000	77,500	30.0	34.0	.31*, .29	Do.
Do	33,000	73,500	19.5	27.4	.18, .21*	Do.
Do	35,350	74,350	19.5	20.5	.20*, .19	Do.
Do	35,350	76,400	30.0	30.7	.33*, .27	Do.
Do	29,000	69,150	31.0	27.4	.35*, .27	Do.
Do	37,400	74,750	26.5	27.4	.26*, .27	Do.
Do	34,300	74,550	29.5	30.7	.28*, .21	Do.
Do	37,500	77,850	23.5	23.9	.22, .25	Do.
Do	33,000	74,850	30.5	30.7	.31*, .30	Do.
Do	22,350	38,450	7.0	13.2	.04, .10*	Lavender and yellow intermingled.
Do	31,000	46,250	7.0	13.2	.09*, .05	Do.
Do	22,350	40,000	7.5	13.2	.10*, .05	Dark lavender and yellow.
Do	23,500	47,300	12.5	16.9	.10, .15*	Lavender and yellow.
Do	28,000	37,400	5.5	13.2	.03, .08*	Do.
Do	23,900	47,300	10.0	13.2	.11*, .09	Do.
Do	24,950	36,900	4.5	5.7	.04*, .05	Do.
Do	38,450	73,800	21.0	23.9	.20, .22*	Uniform light yellow.
Do	34,800	75,300	23.0	23.9	.22, .24*	Do.
Do	37,400	76,500	32.0	30.7	.32*, .32*	Do.
Do	21,300	22,850	0.	....	.00, .00	Lavender and lemon yellow.
Do	16,500	16,500	0.	....	.00, .00	Dark yellow; spongy.
Do	34,500	77,500	19.0	16.9	.18, .20	Uniform light yellow.
Do	21,000	34,500	8.5	16.9	.07, .10*	Light yellow.
Do	19,500	62,500	37.5	34.0	.39*, .36	Uniform light yellow.
Do	20,000	47,000	12.0	13.2	.12, .12	Lemon yellow and lavender.
Do	21,000	60,100	21.5	23.9	.22*, .21	Light lavender.
Do	23,000	57,500	17.0	20.5	.17, .17*	Do.
Do	25,500	59,300	20.5	27.4	.22*, .19	Uniform light yellow.
Do	24,900	61,500	26.0	27.4	.28*, .24	Do.
Do	19,000	52,000	19.0	20.5	.17, .21*	Do.

Bronze—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

Description.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″	
12-inch disappearing carriage	19,500	52,500	19.0	20.5	.21*, .17	Uniform light yellow.
Do	17,000	51,000	20.0	27.4	.17, .23*	Lavender and yellow.
Do	29,000	74,500	10.0	13.2	.09*, .11*	Uniform light yellow.
Do	24,500	58,500	19.0	20.5	.22*, .16	Lavender and light yellow.
Do	26,500	59,000	20.5	27.4	.21*, .20	Light yellow.
Do	23,500	57,500	19.5	23.9	.18, .21*	Do.
Do	18,000	34,500	10.0	13.2	.07, .13*	Lemon yellow.
Do	31,000	76,500	31.0	27.4	.33*, .29	Uniform light yellow.
Do	30,500	72,500	27.5	27.4	.32*, .23	Do.
Do	24,500	57,000	22.5	27.4	.21, .24*	Lavender and yellow.
Do	22,000	61,000	31.0	30.7	.36*, .26	Light yellow; oblique.
Do	24,500	49,500	14.5	20.5	.15, .14	Lavender and yellow.
Do	21,000	54,500	23.0	23.9	.26*, .20	Do.
Do	20,500	29,000	9.5	13.2	.12*, .07	Golden yellow.
Do	22,000	39,500	17.0	16.9	.18*, .16	Lavender and light yellow.
Do	21,000	50,200	29.5	30.7	.27, .32*	Light yellow.
Do	22,000	58,500	22.0	23.9	.23*, .21	Do.
Do	21,000	43,000	8.5	20.5	.06, .11*	Lemon and light yellow.
Do	24,000	60,000	25.5	27.4	.22, .29*	Light yellow.
Do	24,500	59,500	24.0	23.9	.25*, .23	Do.
Do	32,500	49,500	6.0	18.2	.02, .10*	Light yellow; greenish spot.
Do	33,000	57,000	9.0	20.5	.12*, .06	Light and lemon yellow.
Do	36,000	57,000	9.5	16.9	.11*, .08	Light yellow; dark spots.
Do	32,000	72,500	22.5	27.4	.24*, .21	Light yellow.
Do	30,500	70,000	20.5	27.4	.23*, .18	Do.
Do	22,500	56,500	21.0	27.4	.23*, .19	Light yellow; lemon yellow spots.
Do	25,500	55,500	22.5	27.4	.20, .25*	Do.
Do	24,500	57,000	25.5	27.4	.23, .28*	Do.
Do	22,500	54,000	18.0	23.9	.21*, .15	Do.
Do	30,500	75,500	30.0	34.0	.26, .34*	Light yellow.
Do	33,000	74,500	34.0	40.3	.27, .41*	Do.
Do	31,000	74,000	30.5	40.3	.23, .38*	Do.
Do	21,500	72,500	21.5	23.9	.19, .24*	Do.
Do	29,500	72,500	22.0	23.9	.19, .25*	Do.
Do	32,000	75,000	33.0	37.1	.28, .38*	Do.
Do	32,000	59,500	28.0	27.4	.23, .23*	Light and lemon yellow.
Do	22,000	53,500	18.5	20.5	.15, .22*	Do.
Do	26,500	50,500	12.5	16.9	.10, .15*	Do.

Do.	26,500	63,500	25.0	27.4	.24, .26*	Light yellow.
Do.	26,000	62,500	29.5	23.9	.31*, .28	Do.
Dummy shot bands	31,600	50,960	5.3	....	.05, .06, .05	Greenish yellow; spongy. Fractured in head.
Do.	25,450	46,900	12.0	13.2	.08, .16*	Lavender and yellow.
Do.	24.500	51,500	17.5	23.9	.20*, .15	Light yellow.
Do.	19,500	49,600	13.5	23.9	.11, .16*	Lavender color.
Do.	24,500	49,900	11.5	13.2	.14*, .09	Lavender and lemon yellow.
Do.	26,500	44,500	10.0	16.9	.07, .13*	Yellow and lavender.
Do.	26,500	59,000	20.5	23.9	.23*, .18	Light yellow; lemon yellow spots.
Dummy extractor hooks	31,000	73,000	36.0	30.7	.38*, .34	Light yellow.
Do.	33,500	74,000	21.5	27.4	.20, .23*	Do.
Do.	32,500	75,500	33.5	34.0	.35*, .32*	Do.
Do.	34,500	75,000	32.0	37.1	.25, .39*	Do.
Do.	31,500	75,500	33.5	37.1	.38, .29	Do.
Do.	25,500	59,000	14.0	16.9	.12, .16*	Lavender and light yellow.

FROM NEW YORK ARSENAL.

Tobin bronze forging	1	17,100	56,300	63.0	48.5	.63	Light yellow; fine silky. Opened longitudinal seams.
Do.	2	22,000	56,400	56.0	43.3	.56	Do.
Do.	3	28,500	59,200	64.0	52.2	.64	Light yellow; fine silky. Cup shaped. Longitudinal seam.
Do.	4	23,500	59,800	51.0	40.6	.51	Light yellow; fine silky. Longitudinal seam.
Do.	5	28,000	59,800	70.0	60.4	.70	Light yellow; fine silky. Cup shaped.
Do.	6	22,000	55,600	76.0	59.3	.76	Do.
Do.	7	21,800	56,500	55.0	43.3	.55	Light yellow; fine silky. Longitudinal seam.
Do.	8	28,000	60,100	59.0	48.5	.59	Do.
Do.	9	24,900	56,700	60.0	47.2	.60	Do.
Do.	10	28,500	58,800	63.0	48.5	.63	Do.
Do.	11	23,000	56,700	67.0	52.2	.67	Do.

FROM BUILDERS IRON FOUNDRY.

10-inch disappearing carriage	30,560	66,560	25.0	23.1	.25*	Light yellow; oblique.
Do.	26,400	59,600	12.0	18.3	.09, .15*	Light yellow and lavender; irregular.
Do.	24,800	52,400	9.5	18.3	.07, .12*	Do.
Do.	24,800	45,600	9.0	11.8	.06, .12*	Lemon yellow; irregular.
Do.	23,600	53,600	9.0	15.0	.06, .12*	Do.
Marks, C R B 1	52,000	66,100	12.0	18.6	.19*, .05	Light yellow; silvery spot; oblique.
Marks, B 2	21,000	48,600	20.0	....	.21, .19	Fractured in the head.
Marks, 4 R B 3	38,400	60,400	36.5	45.4	.44*, .29	Uniform light yellow; oblique.
Marks, C R B 10 C	23,700	56,360	57.0	62.2	.39, .75*	Light yellow; silky.
Marks, C R B 1 C	45,000	63,000	43.5	60.8	.33, .54*	Do.
Marks, C R B 9 C	39,600	61,040	44.0	57.6	.28, .60*	Fine silky; uniform light yellow
Marks, C R B 7 C	39,600	59,000	46.5	62.2	.39, .54*	Do.

Bronze—Continued.

FROM ARCHIBALD WHEEL COMPANY.

Description.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″	
75-millimeter mountain gun carriage	12,800	25,200	13.5	20.0	.18*, .09	Lavender and light yellow.
Do	....	25,850	22.0	15.2	.22*	Golden yellow.
Do	....	32,240	28.0	23.5	.28*	Light yellow.

FROM HYDE WINDLASS COMPANY.

Coupon on casting	23,110	57,080	29.0	28.8	.33*, .25	Uniform light yellow; oblique.

FROM THE WILLIAM CRAMP & SONS SHIP AND ENGINE BUILDING COMPANY.

Coupon on casting	28,400	66,400	41.3	45.4	.31, .54*, .35	Uniform light yellow; oblique.

FROM CROWN SMELTING COMPANY.

Coupon on casting	19,800	60,800	50.0	47.2	.42, .67*, .41	Fine silky; light, brownish yellow.

GUN HOOPS.

HYDROSTATIC, TENSILE, AND MANDREL TESTS.

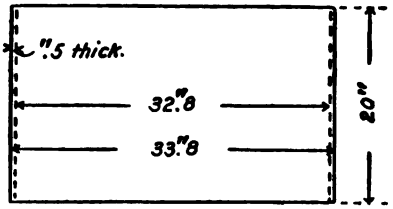
HYDROSTATIC TESTS OF GUN HOOPS.

HOOPS Nos. 23218 B_2, 20963 B_1, 20436 B_2, AND 2837.

DETAILS OF TESTS.

HYDROSTATIC TEST OF STREAKED HOOP 23218 B_2.

Walls of hoop reduced to ½ inch in thickness.



Outside diameter of hoop, 33".8; circumference, 106".186.

$$P = \frac{3(R_1^2 - R_0^2)}{4(R_1^2 + 2R_0^2)}\,\theta$$

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
100	3,364	0.	Initial load.
2,050	68,964	....	Elastic limit; rapid yielding.
2,100	70,646	....	Partial stretch given the hoop.
100	3,364	.0936	
2,100	70,646	....	
100	3,364	.2000	
2,400	80,738	....	
100	3,364	....	Circumference, 107".87.
2,450	82,420	....	
2,850	95,877	....	
100	3,364	....	Circumference...... Top...... 110".25 5" down...... 111".25 Bottom...... 112".87
2,900	97,559	....	
100	3,364	....	Circumference ..... Top...... 110".37 5" down...... 111".87 Bottom...... 113".44
Length at close of test, 19".45 to 19".60. At maximum circumference the hoop has now expanded 7".25=6.8 per cent. Test discontinued and ends faced off to length of 19".28.			
2,930	98,568	....	
100	3,364	....	Circumference...... Top...... 111".75 5" down...... 113".00 Bottom...... 113".75
2,910	97,895	....	
100	3,364	....	Circumference...... Top...... 112".00 5" down...... 113".12 Bottom...... 113".75
2,910	97,895	....	
100	3,364	....	Circumference...... Top...... 112".50 5" down...... 113".62 Bottom...... 113".75
Ten short longitudinal cracks opened in different parts of the exterior cylindrical surface in the lines of streaks.			
2,910	97,895	....	
100	3,364	....	Circumference...... Top...... 113".00 5" down...... 113".94 Bottom...... 113".88 Interior diameter at top, 34".90 to 35".04. Interior diameter at bottom, 35".04 to 35".48.
Test discontinued and ends again faced off.			
2,910	97,895	....	
100	3,364	....	Circumference...... Top...... 113".12 5" down...... 114".00 Bottom...... 113".88
2,923	98,333	....	
100	3,364	....	Circumference...... Top...... 113".30 5" down...... 114".35 Bottom...... 113".94
2,907	97,794	....	

DETAILS OF TESTS—Continued.

HYDROSTATIC TEST OF STREAKED HOOP 23218 B_2—Continued.

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
100	3,364	....	Circumference...... Top........ 113″.38 5″ down........ 114″.50 Bottom........ 114″.00
2,917	98,131	....	
100	3,364	....	Circumference...... Top........ 113″.50 5″ down........ 114″.75 Bottom........ 114″.00
974	32,766	....	Load left on hoop at 4 p. m.
838	28,191	....	Load found on hoop at 8 a. m. the following morning.
2,923	98,333	....	
100	3,364	....	Circumference...... Top........ 113″.75 5″ down........ 114″.94 Bottom........ 114″.15
2,910	97,895	....	
100	3,364	....	Circumference...... Top........ 114″.02 5″ down........ 115″.12 Bottom........ 114″.25
2,897	97,458	....	
100	3,364	....	Circumference...... Top........ 114″.37 5″ down........ 115″.37 Bottom........ 114″.37
2,884	97,021	....	
100	3,364	....	Circumference...... Top........ 114″.75 5″ down........ 115″.62 Bottom........ 114″.37
2,884	97,021	....	
Packing blew out.			Circumference...... Top........ 114″.87 5″ down........ 115″.50 Bottom........ 114″.37

Maximum circumference (at middle of length), 116″.12.
Maximum expansion (at middle of length), 9″.93 = 9.35 per cent.
Hydrostatic test of hoop discontiuned.

Hoop cut into four rings, which were subsequently cut apart in one place radially, straightened cold between rolls, and the strips tested by direct tension. The straightening was from the cylindrical form. In the direction of the length of the hoop the strips were very crooked after passing through the rolls.

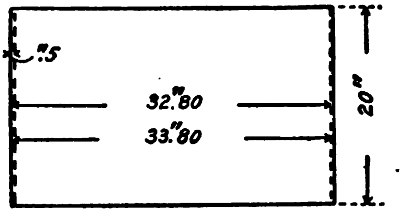
STREAKED HOOP 23218 B_2.

TENSILE TESTS OF FOUR STRIPS WHICH WERE CUT FROM HOOP AFTER HYDROSTATIC TEST.

Location of strip in hoop.	Minimum sectional area.	Tensile strength.		Elongation in 80″.	Contraction of area.	Elongation of 5-inch sections.	Fracture.
		Total.	Per square inch.				
	Sq. inches.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″ ″ ″	
Top	1.98	219,200	110,710	4.4	12.6	.11, .16, .14, .17, .19, .17, .12, .18, .24, .17, .19, .27, .20, .25, .55, .40*.	Fractured at a streaky spot about ″.08 by ″.18 at edge of strip, outside corner. Appearance, granular, radiating from the streaky spot. A nebulous spot of streaky, discontinuous metal existed in the strip 3″ from the place of fracture, measuring ¾″ over all, in a transverse direction to the axis of the strip.
Upper intermediate	2.18	239,400	109,820	3.9	9.2	.12, .13, .10, .17, .20, .26, .23, .52*, .37, .27, .19, .19, .11, .09, .09, .08.	Fractured at a streaky spot about ″.25 by ″.15 at edge of strip, outside corner. Appearance, granular, radiating from the streaky corner. The fracture occurred between two prominent nebulous streaks, 4″ from one, 4½″ from the other.
Lower intermediate	2.24	246,400	110,000	4.2	25.9	.23, .21, .30, .25, .32, .91*, .26, .30, .24, .21, .18, .13, .11, .08, .06, .05.	Appearance of fracture, silky 50 per cent at middle of width, granular 50 per cent at edges of strip.
Bottom	2.39	264,500	110,670	4.0	17.2	.29, .41, .26, .38, .20, .16, .11, .10, .08, .08, .08, .10, .12, .18, .26, .38.	Appearance of fracture, granular, radiating from a silky section at one edge of the strip. The metal drew down locally in an oblique direction, beginning at the silky section of the fractured surface.

HYDROSTATIC TEST OF STREAKED HOOP 20963 B_1.

Walls of hoop reduced to ½″ in thickness.



Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
100	3,364	0.	Initial load.
2,080	69,973	....	Elastic limit; decided yielding.
2,210	74,347	....	
1,000	33,641	.7971	
2,370	79,729	....	Circumference, 107″.05.
2,440	82,084	....	Momentarily reached. Circumference, 107″.25.
Test discontinued and ends of hoop faced off flat, reducing length to 18″.90. Returned to the testing fixture and loads resumed.			
2,400	80,738	....	Sustained load ½ minute.
100	3,364	....	Circumference, 107″.80.
2,500	84,103	....	
100	3,364	....	Circumference, 108″.20.
2,600	87,467	....	
100	3,364	....	Circumference, 108″.60.
2,700	90,831	....	
100	3,364	....	Circumference, 109″.15.
2,800	94,195	....	
100	3,364	....	Circumference, 110″.00.
2,840	95,540	....	
100	3,364	....	Circumference...... Top........................... 108″.75 Middle........................ 110″.25 Bottom........................ 112″.25
2,860	96,213	....	
100	3,364	....	Circumference...... Top........................... 108″.87 Middle........................ 110″.87 Bottom........................ 112″.80
2,875	96,718	....	
100	3,364	....	Circumference...... Top........................... 109″.00 Middle........................ 111″.25 Bottom........................ 114″.00
2,875	96,718	....	
100	3,364	....	Circumference, bottom, 114″.25.
2,875	96,718	....	
100	3,364	....	Circumference, bottom, 115″.12. Length ranges from 18″.30 to 18″.60.
2,875	96,718	....	
100	3,364	....	Circumference...... Top........................... 109″.20 Middle........................ 112″.00 Bottom........................ 115″.75

Packing blew out upon release of pressure.

In addition to the greater circumferential expansion of the hoop at the lower end, the metal yielded more on one side than the other, which, measured in a radial direction, showed an expansion on one side of ⅝″ beyond the opposite end, and 2″ beyond the opposite end on the other side—i. e., the axis is oblique and not normal to the end surfaces. The length ranged from 18″.18 to 18″.58.

Hydrostatic test of hoop discontinued.

Hoop cut into four rings, which were subsequently cut apart in one place radially, straightened cold between rolls, and the strips tested by direct tension. The straightening was from the cylindrical form. In the direction of the length of the hoop the strips were very crooked after passing through the rolls.

STREAKED HOOP 20963 B_1.

TENSILE TESTS OF FOUR STRIPS WHICH WERE CUT FROM HOOP AFTER HYDROSTATIC TEST.

Location of strip in hoop.	Sectional area at middle of length.	Tensile strength.		Elongation in 30″.	Contraction of area.	Elongation of 5-inch sections.	Fracture.
		Total.	Per square inch.				
	Sq. in.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″ ″ ″	
Top	2.15	233,200	108,470	6.9	32.1	.28, .22, .25, .16, .29, .27, .24, .28, .29, .33, .32, .38, .38, .40, 1.12*, .30.	Appearance of fracture, silky, 60 per cent; granular, 40 per cent.
Upper intermediate	2.20	238,700	108,500	5.3	30.0	.16, .17, .19, .16, .19, .18, .26, .34, .17, .81*, .33, .25, .29, .24, .24, .24.	Appearance of fracture, silky, 60 per cent; granular, at sides 40 per cent.
Lower intermediate	2.18	235,900	108,210	5.0	30.7	.25, .24, .27, .20, .20, .30, .25, .18, .17, .16, .17, .16, .19, .19, .22, .86*.	Appearance of fracture, silky, 70 per cent; granular, at sides, 30 per cent.
Bottom	2.17	233,700	107,700	2.5	22.6	.17, .14, .12, .13, .11, .14, .15, .15, .15, .19, .13, .10, .10, .08, .08, .07.	Fractured 1″.85 outside the 30″ gauged length. Appearance of fracture, silky, 60 per cent; granular, 40 per cent. Fractured at the end of the strip having the smaller radius of curvature.

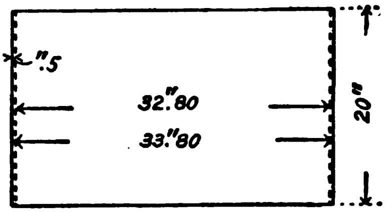
TANGENTIAL TENSILE SPECIMENS TAKEN FROM RING FROM END OF HOOP.

The ring which furnished these specimens was removed from the hoop when the latter was turned down to ½″ walls.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Elongation of inch sections.	Fracture.
	Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″	
20963B_1	.564	.25	65,200	106,480	21.3	39.2	.13, .22*, .29*	Silky.
20963B_1	.564	.25	61,600	103,280	17.0	33.5	.10, .17, .24*	Silky, 50 per cent; granular, 50 per cent.

HYDROSTATIC TEST OF STREAKED HOOP 20436 B_2.

Walls of hoop reduced to ½" thickness.



Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
1,000 to 850			Hoop remained under load 16 hours.
100	3,364	0.	Initial load.
2,100	70,646		Elastic limit.
100	3,364	—.0070	
2,200	74,010		
100	3,364	.0738	
2,300	77,374		
100	3,364	.3143	
2,400	80,738		
100	3,364		Circumference, 107".50.
2,500	84,102		
100	3,364		Circumference, 107".80.
2,600	87,467		
100	3,364		Circumference, 108".25.
2,700	90,831		
100	3,364		Circumference, 108".70.
2,800	94,195		
100	3,364		Circumference, 109".50.
Test discontinued.			
Hoop faced off at ends, reducing length to 18".62, and test resumed.			
2,850	95,877		
1,000	33,641		Load left on hoop over night.
885	29,772		Load found on hoop in the morning.
2,891	97,256		
2,884	97,021		
100	3,364		Circumference...... Top........ 109".45 Middle........ 110".60 Bottom........ 111".20
2,900	97,559		
100	3,364		Circumference...... Top........ 109".60 Middle........ 110".80 Bottom........ 111".35
2,943	99,005		
100	3,364		Circumference...... Top........ 110".30 Middle........ 111".87 Bottom........ 112".75
2,943	99,005		
0	0		Circumference...... Top........ 110".35 Middle........ 112".15 Bottom........ 112".95
Packing blew out. Test discontinued.			
Diameters: Top end, 34".13 to 34".15; bottom end, 34".95 to 35".04.			
Lengths: 18".31 to 18".50.			
Hoop faced off at ends, reducing length to 18".22, and test resumed.			
3,000	100,923		
100	3,364		Circumference...... Top........ 111".00 Middle........ 112".62 Bottom........ 113".25
3,000	100,923		
100	3,364		Circumference...... Top........ 111".37 Middle........ 113".00 Bottom........ 113".37
New packing inserted at one end of the hoop.			
3,021	101,629		
3,008	101,192		
100	3,364		Circumference...... Top........ 111".62 Middle........ 113".75 Bottom........ 114".00
3,014	101,394		

Hydrostatic Test of Streaked Hoop 20436 B$_2$—Continued.

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
100	3,364	....	Circumference...... Top............ 112″.00 Middle............ 114″.93 Bottom............ 115″.25
2,985	100,418	....	
100	3,364	....	Circumference...... Top............ 112″.25 Middle............ 115″.62 Bottom............ 116″.00
Packing blew out and hoop removed from testing fixture. The metal at one place on the exterior surface showed an opening ″.05 in length by ″.01 in width. No change in the appearance of the surfaces was found elsewhere. Ends of hoops were again faced off, reducing length to 17″.75, and test resumed.			
2,985	100,418	....	
100	3,364	....	Circumference...... Top............ 112″.40 Middle............ 116″.40 Bottom............ 117″.35
2,950	99,241	....	
100	3,364	....	Circumference, bottom............ 117″.45
2,985	100,418	....	
100	3,364	....	Circumference...... Top............ 112″.25 Middle............ 116″.50 Bottom............ 118″.25
2,985	100,418	....	Packing blew out.
100	3,364	....	Circumference...... Top............ 112″.30 Middle............ 117″.00 Bottom............ 118″.87

Maximum elongation (at bottom of hoop), 12″.74 = 12 per cent. Hydrostatic test discontinued. No change in appearance of opening above noted on exterior surface. Streaks on interior surface of hoop show short, minute openings when examined with a hand glass. Prominence of streaks slightly increased at bore, on outside surface not generally visible.

Hoop cut into four rings, which were subsequently cut apart in one place radially, straightened cold between rolls, and the strips tested by direct tension. The straightening was from the cylindrical form. In the direction of the length of the hoop the strips were very crooked after passing through the rolls.

Streaked Hoop 20436 B_2.

TENSILE TESTS OF FOUR STRIPS WHICH WERE CUT FROM HOOP AFTER HYDROSTATIC TEST.

Location of strips in hoop.	Sectional area at middle of length.	Tensile strength.		Elongation in 70 inches.	Contraction of area.	Elongation of 5-inch sections.	Fracture.
		Total.	Per square inch.				
	Sq. ins.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	" " " " "	
Top	2.03	230,900	113,740	4.0	26.6	.08, .08, .10, .14, .15, .18, .19, .32, .84*, .21, .16, .13, .10, .10	Appearance of fracture, silky, 50 per cent; granular, at sides, 50 per cent.
Upper intermediate	2.01	230,500	114,680	3.8	25.9	.11, .10, .10, .13, .17, .15, .22, .25, .79*, .19, .14, .11, .10, .10	Appearance of fracture, silky, 40 per cent; granular, at sides, 60 per cent.
Lower intermediate	2.03	233,700	115,120	2.5	15.8	.06, .06, .06, .09, .15, .37*, .37, .13, .09, .10, .08, .07, .06, .08	Appearance of fracture, granular, radiating from a silky, serrated spot ".35 by ".08 at one surface of strip.
Bottom	2.01	234,000	116,420	2.6	21.4	.07, .06, .06, .06, .08, .08, .13, .61*, .29, .12, .07, .06, .05, .07	Appearance of fracture, silky, 40 per cent; granular, 60 per cent; irregular surface.

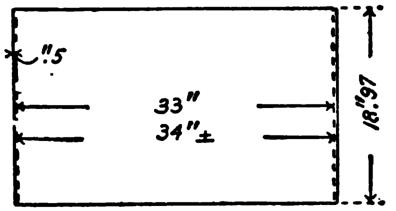
TANGENTIAL TENSILE SPECIMENS TAKEN FROM RING FROM END OF HOOP.

The ring which furnished these specimens was removed from the hoop when the latter was turned down to ½" walls.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Elongation of inch sections.	Fracture.
	Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
20436 B_2	.564	.25	63,200	101,040	20.7	49.7	.12, .38*, .12	Silky.
20436 B_2	.564	.25	63,200	102,080	19.0	47.2	.21*, .36*, .10	Do.

HYDROSTATIC TEST OF STREAKED HOOP No. 2837.

Walls of hoop reduced to ½" in thickness.



Thickness of walls varies from ".498 to ".514.

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
100	3,384	0.	Initial load.
1,900	64,298	....	Elastic limit below 64,298 pounds.
100	3,384	.0588	
2,000	67,682	....	
100	3,384	.1150	
2,100	71,066	....	
100	3,384	....	Circumference...... Top........................ 107".50 Middle........................ 107".50 Bottom........................ 107".40
2,200	74,450	....	
100	3,384	....	Circumference...... Top........................ 107".75 Middle........................ 107".80 Bottom........................ 107".75
2,300	77,834	....	
100	3,384	....	Circumference...... Top........................ 108".20 Middle........................ 108".30 Bottom........................ 108".20
2,400	81,218	....	
100	3,384	....	Circumference...... Top........................ 108".55 Middle........................ 108".70 Bottom........................ 108".62
2,500	84,603	....	
100	3,384	....	Circumference...... Top........................ 109".10 Middle........................ 109".20 Bottom........................ 109".10
2,580	87,310	....	Packing blew out.
100	3,384	....	Circumference...... Top........................ 109".25 Middle........................ 109".30 Bottom........................ 109".30
Test discontinued. No change in appearance of streaks. Interior diameters range from 33".70 to 33".88. Ends faced off, reducing length of hoop to 18".60, new packing put in place and hydrostatic test resumed.			
2,650	89,679	....	
100	3,384	....	Circumference...... Top........................ 109".30 Middle........................ 109".90 Bottom........................ 109".70
2,700	91,371	....	Ultimate strength.
0	0	....	Circumference...... Top........................ 109".30 Middle........................ 110".12 Bottom........................ 110".82

Maximum expansion (at bottom of hoop), 3.8 per cent.

Hoop ruptured beginning at the exterior surface 1" from the upper end. The line of fracture followed a direct longitudinal course for a distance of 2⅝", after which the course was somewhat zigzag to the opposite end. Oblique cracks branched from the main line of fracture, penetrating the metal on either side from ¾" to 5".

Appearance of fractured surface, granular, radiating from point of beginning 1" from the upper end of the hoop. Dimensions of fractured section, 18".48 by about ".498. Thickness of fractured edge ranged from ".505 at upper end of the hoop to ".494 near the bottom end.

Hoop was cut into four rings, which were subsequently straightened cold between rolls. The straightening was from the cylindrical form.

Top and lower intermediate strips fractured in the rolls while being straightened cold, the top one fracturing in three places and lower intermediate in two. The bottom strip was straightened successfully and tested by direct tension.

STREAKED HOOP NO. 2837.

TENSILE TEST OF STRIP WHICH WAS CUT FROM HOOP AFTER HYDROSTATIC TEST.

Location of strip in hoop.	Sectional area at middle of length.	Tensile strength.		Elongation in 70 inches.	Contraction of area.	Elongation of 5-inch sections.	Fracture.
		Total.	Per square inch.				
	Sq. ins.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″ ″ ″	
Bottom................	2.74	264,600	96,570	1.6	5.1	.20*, .21, .13, .08, .06, .05, .05, .05, .08, .07, .05, .04, .03, .04	Appearance of fracture, granular, radiating from a point at the outside surface, and near the middle of width of the strip, in the line of a streak.

CHEMICAL ANALYSES OF FRAGMENTS OF TOP STRIP.

Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
.500	.790	.250	.024	.030
.480	.750	.248	.024	.030

TENSILE TESTS OF STRIPS FROM GUN HOOP.

HOOP No. 24606 B_2.

TENSILE TESTS OF METAL FROM STRAIGHTENED AND RE-TREATED STREAKED HOOP 24606 B_2.

No. 10695.

Strip No. 2, full thickness of hoop.
Sectional area, maximum, 2″.97 by 1″.331 =3.95 square inches.
Sectional area, minimum, 2″.91 by 1″.331 =3.87 square inches.
Gauged length, 50″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,337	0.	0.	Initial load. Pounds per square inch figured on the maximum area excepting the breaking load, which is taken on the minimum area.
6,684	.0095	....	
13,367	.0213	....	
20,051	.0333	....	
26,734	.0450	.0004	
33,418	.0568	....	
40,101	.0685	.0006	
46,785	.0806	....	
53,468	.0929	.0014	
54,805	.0948	....	
56,142	.0981	....	Rapid stretching.
57,478	.1054	....	
58,815	.1121	....	
60,152	.1194	....	
61,489	.1290	....	
62,825	.1405	....	
64,162	.1547	....	
65,499	.1707	....	
66,835	.1980	.0734	
73,519	.55	....	
80,203	.89	....	
86,886	1.30	....	
93,590	1.86	....	
100,253	3.06	....	
104,419	....	....	Tensile strength (minimum sectional area).
0	5.60	....	=8 per cent elongation in 70″.

Elongation of 5-inch sections: ″.69, ″.48, ″.41, ″.37, ″.33, ″.34, ″.34, ″.37, ″.42, ″.43, ″.39, ″.37, ″.36, ″.32.

Contraction of area, 15.2 per cent.

Appearance of fracture, granular, radiating from the outside corner of the strip. Fractured at face of jaws, 20″ from end of strip. A silky, serrated section was shown ″.10 by ″.05 at the place where rupture began.

A second test, made on the longer end of the strip, resulted as follows:

Tensile strength, per square inch	pounds..	103,870
Elongation in 55″	per cent..	10.6
Contraction of area	do....	14.2

Appearance of fracture, granular, radiating from a point on the outside edge of the strip. A silky, serrated section ″.35 by ″.06 was shown at the place where rupture began.

Elongation of 5-inch sections: ″.43, ″.40, ″.44, ″.46, ″.56*, ″.66, ″.71, ″.61, ″.55, ″.54, ″.48.

A third test, made on the longer remaining end, resulted as follows:

Tensile strength, per square inch	pounds..	103,590
Elongation in 15″	per cent..	17.8
Contraction of area	do....	25.1

Appearance of fracture, granular, radiating from a silky, serrated spot at the middle of the outside edge of the strip. The strip drew down in width to 2″.58 about 1″ from the fractured surface. The serrated spot measured ″.5 by ″.2.

Elongation of 5-inch sections: ″.90*, 1″.10*, ″.67.

No. 10695a.

Strip No. 5, full thickness of hoop.

Sectional area, at middle of length, 3.82 square inches.

Two gauged lengths of 10″ each established at middle of length of strip.

Gauged length A, $\frac{1}{16}$″ from concave edge.

Gauged length B, $\frac{1}{16}$″ from convex edge.

Applied loads per square inch.	Elongation in gauged length.		Remarks.
	A.	B.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0020	.0005	
10,000	.0047	.0012	
15,000	.0071	.0019	
20,000	.0098	.0025	
25,000	.0121	.0032	
30,000	.0147	.0036	
35,000	.0170	.0044	
40,000	.0191	.0052	
1,000	.0007	−.0001	
45,000	.0215	.0073	
50,000	.0241	.0080	
1,000	.0015	−.0010	
52,000	.0253	.0081	
54,000	.0270	.0082	
56,000	.0290	.0081	
58,000	.0326	.0088	
60,000	.0358	.0106	
1,000	.0110	−.0036	
62,000	.0380	.0125	
64,000	.0405	.0148	
66,000	.0440	.0176	
68,000	.0482	.0232	Rapid stretching.
70,000	.0820	.0600	
1,000	.0551	.0359	
5,000	.0557	.0365	
10,000	.0575	.0377	
20,000	.0612	.0408	
30,000	.0650	.0443	
40,000	.0690	.0472	
50,000	.0730	.0509	
1,000	.0540	.0353	Rested under 1,000 pounds per square inch 42 hours.
1,000	.0536	.0353	
5,000	.0550	.0359	
10,000	.0570	.0371	
20,000	.0607	.0402	
30,000	.0646	.0435	
40,000	.0682	.0470	
50,000	.0723	.0505	
1,000	.0538	.0355	
50,000	.0723	.0505	
60,000	.0769	.0545	
70,000	.0831	.0613	
72,000	.0920	.0700	
74,000	.1161	.0936	
76,000	.1330	.1092	
78,000	.1540	.1308	
80,000	.1769	.1538	
1,000	.1421	.1208	
103,270	....	....	Tensile strength.

Elongation of 5-inch sections: ″.53*, ″.48, ″.35, ″.35, ″.34, ″.36, ″.39, ″.43, ″.50, ″.54, ″.49, ″.44, ″.35, ″.32.

Elongation in 70″, 5″.87 = 8.4 per cent.

Contraction of area, 9.2 per cent.

Fractured 7″ from face of jaws. Appearance of fracture, granular, radiating from a point in the outside edge of the strip. Fracture began at a place having a silky, serrated appearance, ″.20 by ″.12.

No. 10695b.

Strip No. 8, full thickness of hoop.

Sectional area, at middle of length, 4.45 square inches.

Two gauged lengths of 10″ each established along middle of length of strip.

Gauged length A, $\frac{1}{16}$″ from concave edge.

Gauged length B, $\frac{1}{16}$″ from convex edge.

Applied loads per square inch.	Elongation in gauged length.		Remarks.
	A.	B.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0020	.0004	
10,000	.0046	.0006	
20,000	.0099	.0015	
30,000	.0146	.0031	
40,000	.0190	.0049	
1,000	.0002	.0002	
45,000	.0215	.0060	
50,000	.0242	.0065	
1,000	.0012	−.0006	
52,000	.0255	.0069	
54,000	.0269	.0069	
56,000	.0290	.0071	
1,000	.0043	−.0024	
58,000	.0329	.0084	
60,000	.0362	.0097	
1,000	.0117	−.0030	
62,000	.0387	.0124	
64,000	.0389	.0164	
1,000	.0142	−.0011	
66,000	.0401	.0182	
68,000	.0461	.0215	Rapid stretching.
70,000	.0842	.0592	
1,000	.0560	.0357	
5,000	.0576	.0361	
10,000	.0592	.0370	
20,000	.0630	.0400	
30,000	.0672	.0434	
40,000	.0710	.0468	
50,000	.0753	.0505	
1,000	.0562	.0353	

Elongation of 5-inch sections, ″.03, ″.03, ″.03, ″.02, ″.02, ″.02, ″.02, ″.03, ″.03, ″.04, ″.04, ″.04 ″.03, ″.03.

Gauged length C established on two 5-inch sections at middle of length of strip, and on center line. Present length of these sections, 10".05.

Applied loads per square inch.	Elongation in gauged length.	Remarks.
	C.	
Pounds.	*Inch.*	
1,000	0.	Micrometer set at zero.
5,000	.0008	
10,000	.0021	
20,000	.0052	
30,000	.0086	
40,000	.0121	
50,000	.0160	
1,000	.0006	
50,000	.0165	
1,000	.0007	
102,860	....	Tensile strength.

Elongation of 5-inch sections, ".30, ".29, ".29, ".29, ".29, ".30, ".31, ".35, ".43, ".55*, ".50, ".43, ".36, ".30.

Elongation in 70", 4".99 = 7.1 per cent.

Contraction of area, 11.3 per cent.

Fractured 27" from face of jaws. Appearance of fracture, granular, radiating from a point at the outside corner of the strip. Fractured at place of minimum sectional area, beginning at a silky, serrated section ".14 by ".16.

No. 10695c.

Strip No.3, full thickness of hoop.

Sectional area, at middle of length, 4.29 square inches.

Two gauged lengths of 10″ each established along middle of length of strip.

Gauged length A, $\frac{1}{16}$″ from concave edge.

Gauged length B, $\frac{1}{16}$″ from convex edge.

Applied loads per square inch.	Elongation in gauged length.		Remarks.
	A.	B.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0020	.0002	
10,000	.0046	.0006	
20,000	.0098	.0019	
30,000	.0144	.0036	
40,000	.0190	.0055	
1,000	+.0004	+.0004	
45,000	.0216	.0065	
50,000	.0242	.0073	
1,000	+.0016	−.0005	
52,000	.0252	.0073	
54,000	.0267	.0075	
56,000	.0282	.0076	
1,000	+.0038	−.0022	
58,000	.0350	.0078	
60,000	.0430	.0089	
1,000	+.0177	−.0040	
62,000	.0487	.0105	
64,000	.0506	.0136	
1,000	+.0250	−.0026	
66,000	.0526	.0170	
68,000	.0558	.0212	Rapid stretching.
70,000	.0840	.0511	
1,000	.0555	.0289	
5,000	.0570	.0291	
10,000	.0588	.0296	
20,000	.0625	.0325	
30,000	.0663	.0359	
40,000	.0704	.0391	
50,000	.0747	.0426	
1,000	.0554	.0284	

Gauged length C established on two 5-inch sections at middle of length of strip, and on center line. Present length of these sections, 10″.05.

Applied loads per square inch.	Elongation in gauged length.	Remarks.
	C.	
Pounds.	*Inch.*	
1,000	0.	Micrometer set at zero.
5,000	.0009	
10,000	.0022	
20,000	.0058	
30,000	.0094	
40,000	.0126	
50,000	.0164	
1,000	.0010	
50,000	.0165	
1,000	.0010	
102,260	....	Maximum stress; slipped in jaws.
101,400	....	Load at time of fracture.

Elongation of 5-inch sections, ″.43, ″.47, ″.51, ″.49, ″.62, ″.56, ″.52*, ″.45, ″.44, ″.40, ″.41, ″.42, ″.46, ″.51.

Elongation in 70″, 6″.69 = 9.6 per cent.

Contraction of area, 11.7 per cent.

Fractured 35″ from face of jaws.

Appearance of fracture, granular, radiating from a silky, serrated section about ″.90 by ″.10 on the outside edge of the strip.

Straight bar from strip No. 1.
Length, 94".5.
Sectional area, 1".702 by 1".548 =2.63 square inches.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0007	....	
10,000	.0020	....	
20,000	.0053	....	
30,000	.0085	.0010	
40,000	.0117	....	
50,000	.0147	.0009	
55,000	.0164	....	
60,000	.0178	.0010	
61,000	.0181	....	
62,000	.0184	....	
63,000	.0187	....	
64,000	.0190	....	
65,000	.0192	....	
66,000	.0194	....	
67,000	.0196	....	
68,000	.0199	....	
69,000	.0201	....	
70,000	.0204	.0007	Yielding outside the gauged length.
71,000	.0212	....	
72,000	.0217	....	
73,000	.0380	....	
74,000	.0724	....	
75,000	.0825	.0564	
80,000	.16	....	
85,000	.20	....	
90,000	.28	....	
95,000	.36	....	
100,000	.53	....	
103,920	....	....	Tensile strength.

Elongation of 5-inch sections, ".95*, ".97*, ".56, ".55, ".54, ".43, ".42, ".43, ".40, ".40, ".42, ".44.

Elongation in 60", 6".51=10.8 per cent.

Contraction of area, 38.4 per cent.

Appearance of fracture, silky, interspersed with fine granulation. Radiates from center of bar.

CHEMICAL ANALYSIS.

Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
.530	.700	.244	.023	.038

Straight bars taken from strips.
Strip No. 10 cut into halves.

From strip number.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 40 inches.	Contraction of area.	Elongation of 5-inch sections.	Fracture.
		Total.	Per square inch.	Total.	Per square square inch.				
	Sq. inch.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″ ″	
4	2.91	195,000	67,010	304,300	104,570	14.5	21.3	.53, .71, .94*, .88, .92, .71, .61, .50	Appearance of fracture, granular, radiating from a silky spot, slightly serrated, at the outside corner of the strip.
6	2.98	200,600	67,300	309,400	103,830	14.5	19.5	.53, .64, .74, .72, 1.02*, .81, .76, .60	Appearance of fracture, granular, radiating from a silky spot at the outside corner of the strip.
7	2.66	181,400	68,200	278,200	104,590	13.0	27.4	.72, 1.02*, .56, .60, .53, .55, .61, .62	Appearance of fracture, granular, radiating from a silky spot near corner of outside edge of strip.
9	2.77	185,800	67,080	289,000	104,330	12.7	25.2	.48, .60, 1.16*, .72, .62, .56, .50, .44	Appearance of fracture, granular, radiating from a silky spot at the outside corner of the strip.
10a	2.95	217,000	73,560	313,100	106,140	In 10″. 15.4	36.3	″ ″ .56, .98*	Appearance of fracture, silky, interspersed with fine granulation. Radiates from center of the bar.
10b	2.95	217,000	73,560	310,000	105,080	14.2	34.6	.62, .80	Appearance of fracture, granular, radiating from a silky spot at corner of bar. Fractured 1″ outside the gauged length.

CHEMICAL ANALYSIS OF BAR 10a.

Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
.510	.790	.250	.020	.015

TENSILE TESTS OF SPECIMENS FROM GUN HOOPS.

The location of the tangential specimens with reference to the thickness of the walls of the hoops is shown by the letters O, M, and I, signifying they were taken from the outside, middle, and inside parts, respectively. The segment number is affixed to the letter indicating the location of the specimen.

Hoop.	Ring.	Direction.	Location.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″	
A_1 2843	1	Tangential...	O1	60,400	98,800	10.7	11.8	.09, .11, .12*	Granular.
			M1	58,000	100,400	17.7	41.9	.12, .11, .30*	Granular; silky center.
			I1	62,000	101,600	18.0	47.2	.23*, .21, .10	Fine granular, 75 per cent; silky, 25 per cent.
			O2	60,400	97,000	13.0	8.4	.08, .10, .21*	Granular.
			M2	59,600	98,320	11.0	11.8	.10, .13*, .10	Do.
			I2	63,600	101,200	13.7	21.4	.20*, .12, .09	Do.
			O3	60,800	96,400	20.0	27.6	.33*, .15, .12	Granular, 80 per cent; dull, smooth oblique, 20 per cent.
			M3	60,000	97,200	15.3	18.3	.11, .15, .20*	Granular.
			I3	62,400	100,400	19.7	44.6	.10, .16, .33*	Granular, 40 per cent; silky, 60 per cent.
			O4	61,600	100,400	16.7	27.6	.10, .28*, .12	Granular; silky spot at circumference.
			M4	59,200	99,600	16.3	47.2	.07, .30*, .12	Silky.
			I4	63,200	102,400	16.7	44.6	.08, .30*, .12	Do.
			O5	61,600	102,000	19.0	47.2	.10, .20, .27*	Do.
			M5	58,800	101,200	16.3	44.6	.11, .30*, .08	Do.
			I5	61,600	104,400	17.0	44.6	.10, .31*, .10	Do.
			O6	60,800	100,000	17.7	41.9	.09, .25*, .19	Do
			M6	60,800	101,200	11.7	11.8	.10, .12*, .13	Granular.
			I6	63,200	104,400	17.7	47.2	.09, .15, .29*	Silky.
			O8	60,400	102,400	10.0	11.8	.08, .10, .12*	Granular.
			M8	55,200	99,600	18.3	39.2	.30*, .12, .13	Granular, 40 per cent; silky, 60 per cent.
			I8	60,800	103,600	16.0	36.4	.10, .27*, .11	Granular, 60 per cent; silky, 40 per cent.
			O10	61,200	105,200	18.3	44.6	.11, .18, .26*	Silky; trace of granulation.
			M10	56,800	103,600	15.3	21.4	.15, .20*, .11	Granular; silky spot.
			I10	62,000	106,400	16.3	27.6	.27*, .10, .12	Do.
			O12	60,800	106,000	9.3	11.8	.09, .11*, .08	Granular.
			M12	57,600	103,200	14.3	21.4	.11, .16*, .16	Granular; silky spot.
			I12	61,200	106,000	15.3	30.6	.11, .26*, .09	Do.
A_1 2843	1	Radial........	7	53,500	90,500	4.5	5.7	.04, .05*	Granular.
			7	56,500	90,500	5.0	5.7	.05*, .05	Do.
			7	58,000	86,500	4.0	5.7	.04, .04*	Do.
			7	55,000	84,000	4.0	5.7	.05*, .03	Do.
			7	56,000	80,500	3.0	1.8	.03, .03*	Do.
			7	54,900	87,000	4.5	5.7	.05*, .04	Do.
			9	55,000	89,000	4.0	5.7	.03, .05*	Do.
			9	53,500	95,500	6.0	5.7	.05, .07*	Do.
			9	54,000	80,000	3.0	1.8	.04*, .02	Do.
			9	55,000	95,700	6.0	5.7	.05, .07*	Do.

Hoop.	Ring.	Direction.	Location.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
A_1 2843	1	Radial	9	54,900	87,500	4.0	5.7	.03, .05*	Granular.
			9	52,500	92,000	5.0	5.7	.04, .06*	Do.
			11	56,000	97,000	6.0	5.7	.06, .06*	Do.
			11	55,000	88,100	3.0	1.8	.03, .03	Granular; fractured at the neck.
			11	55,000	99,500	8.0	5.7	.07, .09*	Granular.
			11	56,000	94,500	5.0	5.7	.06, .05*	Do.
			11	56,500	92,500	4.0	5.7	.04, .04*	Do.
			11	56,000	88,000	3.5	5.7	.03, .04*	Do.
			13	56,500	90,750	4.5	5.7	.04, .05*	Do.
			13	54,500	95,500	6.0	5.7	.05, .07*	Do.
			13	56,000	90,000	4.0	5.7	.03, .05*	Do.
			13	55,500	89,500	4.5	5.7	.04, .05*	Do.
			13	56,000	85,000	3.0	1.8	.03, .03*	Do.
			13	55,500	84,500	3.5	1.8	.03, .04*	Do.
A_1 2843	3	Tangential...	3O	97,200	108,000	17.3	39.2	.13, .29*, .10	Silky.
			3O	96,800	110,400	13.0	36.4	.05, .11, .23*	Silky; in part granular.
			3O	94,800	110,800	13.3	36.4	.22*, .11, .07	Silky; trace of granulation.
			3O	96,800	108,400	12.7	36.4	.04, .15*, .19*	Do.
			3O	94,400	105,600	14.7	41.9	.14, .24*, .06	Do.
			3O	94,400	110,400	13.0	27.6	.07, .17*, .15*	Silky; in part granular.
			3I	92,000	101,600	17.3	41.9	.26*, .15, .11	Silky.
			3I	91,600	103,200	17.7	41.9	.17, .25*, .11	Do.
			3I	90,400	105,200	16.7	36.4	.20*, .20*, .10	Do.
			3I	92,000	100,800	16.0	41.9	.26*, .14, .08	Do.
			3I	92,400	104,400	18.3	41.9	.11, .19, .25*	Do.
			3I	92,400	105,200	16.0	41.9	.27*, .12, .09	Do.
A_1 2843	3	Radial........	1	(*a*)	101,500	14.0	16.9	.14	Granular.
			1	*b* 58,000	100,500	12.0	27.4	.12	Granular, 70 per cent; silky, 30 per cent.
			2	*b* 60,000	100,000	18.0	23.9	.18	Granular, 40 per cent; silky, 60 per cent.
			2	*b* 59,000	101,000	14.0	27.4	.14	Granular; silky spot at circumference.
			3	*b* 59,000	100,500	18.0	27.4	.18	Granular, 60 per cent; silky, 40 per cent.
			3	*b* 52,000	99,500	17.0	27.4	.17	Granular; silky center.
A_1 2843	4	Tangential...	O1	59,200	100,000	18.0	24.6	.11, .24**. 19	Granular, 85 per cent; silky, 15 per cent.
			M1	54,000	95,200	21.0	41.9	.15, .35*, .13	Granular, 80 per cent; silky, 20 per cent.
			I1	53,200	94,000	21.3	49.7	.18, .34*, .12	Silky; trace of granulation.
			O2	60,800	100,800	16.7	41.9	.10, .25*, .15	Granular; silky center.
			M2	53,600	95,600	20.3	41.9	.18, .29*, .19	Granular, 40 per cent; silky, 60 per cent.
			I2	54,000	94,000	23.3	47.2	.17, .39*, .14	Do.
			O3	61,200	102,000	13.0	18.3	.08, .12, .19*	Granular; with flaky spot.
			M3	52,800	96,000	19.0	44.6	.11, .33*, .13	Granular, 30 per cent; silky, 70 per cent.
			I3	53,600	96,000	21.3	41.9	.12, .25*, .27	Granular, 50 per cent; silky, 50 per cent.

			O8	62,400	106,400	14.7	30.6	.11, .24*, .09	Granular; silky spot.
			M8	55,600	100,000	20.7	41.9	.17, .33*, .12	Silky.
			I8	56,400	100,000	20.3	44.6	.11, .21, .29*	Do.
			O10	63,200	108,800	16.3	39.2	.09, .14, .26*	Do.
			M10	56,000	101,200	18.7	41.9	.19*, .26*, .11	Do.
			I10	58,400	101,200	21.7	44.6	.14, .36*, .15	Do.
			O12	62,800	109,200	15.7	21.4	.10, .23*, .14	Granular.
			M12	56,000	102,000	18.3	39.2	.12, .15, .28*	Silky.
			I12	55,600	101,200	20.3	47.2	.13, .33*, .15	Do.
A₁ 2843	4	Radial........	4	51,500	95,500	15.0	27.4	.07, .23*	Granular; silky center.
			4	52,000	94,700	16.5	30.7	.09, .24*	Granular; silky spot.
			4	51,000	95,200	17.5	30.7	.09, .26*	Granular, 60 per cent; silky, 40 per cent.
			4	51,000	95,200	14.5	27.4	.05, .24*	Granular; silky spot.
			4	51,500	95,100	18.0	34.0	.09, .27*	Granular, 50 per cent; silky, 50 per cent.
			4	51,000	95,100	13.5	20.5	.07, .20*	Granular.
			5	51,000	93,900	16.5	30.7	.09, .24*	Silky oblique, 80 per cent; granular, 20 per cent.
			5	51,000	94,450	16.0	30.7	.24*, .08	Granular, 60 per cent; silky, 40 per cent.
			5	52,000	94,300	18.0	34.0	.10, .26*	Silky; in part granular.
			5	51,000	95,000	17.5	34.0	.09, .26*	Granular, 60 per cent; silky, 40 per cent.
			5	51,000	95,100	16.5	34.0	.08, .28*	Silky; in part granular.
			5	50,500	94,200	17.0	34.0	.09, .25*	Do.
			6	51,000	95,000	16.0	30.7	.08, .24*	Silky, 40 per cent; granular, 60 per cent.
			6	50,100	94,100	17.5	30.7	.09, .26*	Do.
			6	52,500	98,000	15.5	30.7	.06, .25*	Do.
			6	52,500	96,500	15.0	27.4	.08, .22*	Granular; silky spot.
			6	54,000	98,500	13.5	27.4	.20*, .07	Do.
			6	53,000	99,500	15.0	30.7	.23*, .07	Granular, 50 per cent; silky, 50 per cent.
			7	51,000	95,000	15.5	30.7	.23*, .08	Granular, 40 per cent; silky, 60 per cent.
			7	51,500	95,500	16.5	30.7	.07, .26*	Granular, 50 per cent; silky, 50 per cent.
			7	53,000	96,000	16.0	30.7	.10, .22*	Granular; silky spot.
			7	51,000	95,500	16.0	30.7	.07, .25*	Dull silky, 90 per cent; granular, 10 per cent.
			7	51,000	96,000	16.0	30.7	.08, .24*	Granular; silky center.
			7	51,500	95,500	15.5	30.7	.08, .23*	Silky, 60 per cent; granular, 40 per cent.
			9	54,000	99,000	14.0	30.7	.22*, .06	Granular; silky spot.
			9	53,000	99,800	12.5	23.9	.18*, .07	Granular.
			9	53,000	98,900	15.0	34.0	.23*, .07	Granular, 30 per cent; silky, 70 per cent.
			9	53,500	100,500	14.5	27.4	.21*, .08	Granular, 70 per cent; silky, 30 per cent.
			9	54,000	100,000	15.0	30.7	.08, .22*	Granular. 50 per cent; silky, 50 per cent.
			9	56,000	101,500	13.5	27.4	.07, .20*	Granular; silky spot.
			11	55,500	100,500	14.0	27.4	.22*, .06	Granular; silky center.
			11	54,500	99,900	14.0	27.4	.07, .21*	Do.
			11	55,000	99,700	14.5	27.4	.07, .22*	Granular; silky spot.
			11	54,500	100,100	14.5	27.4	.07, .22*	Do.
			11	54,000	100.050	14.0	27.4	.07, .21*	Granular; silky center.
			11	54,000	99,900	14.0	30.7	.07, .21*	Granular; silky spot.
			13	53,000	99,400	13.5	23.9	.07, .20*	Do.
			13	52,500	98,000	14.5	27.4	.07, .22*	Do.
			13	54,000	99,800	14.0	30.7	.06, .22*	Granular; silky center.
			13	53,000	99,000	14.5	30.7	.07, .22*	Granular; silky spot.

a Indefinite.

b Approximate

Hoop.	Ring.	Direction.	Location.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″	
A_1 2843	4	Radial........	13	55,500	99,000	13.0	27.4	.06, .20*	Granular; silky spot.
			13	54,000	99,000	13.5	27.4	.07, .20*	Do.
A_1 5388	1	Tangential...	O1	58,800	98,000	12.0	11.8	.15*, .12, .09	Granular; flaky spot.
			M1	53,200	96,800	13.0	18.3	.10, .12, .17*	Granular; flaky streak.
			I1	57,600	98,400	19.3	49.7	.10, .21, .27*	Silky; trace of granulation.
			O2	55,600	95,200	17.7	30.6	.25*, .18, .10	Granular; silky spot.
			M2	51,600	91,920	19.7	44.6	.34*, 15, .10	Granular, 50 per cent; silky, 50 per cent.
			I2	54,000	95,600	20.7	39.2	.32, *.17, .13	Fine granular, 85 per cent; silky, 15 per cent.
			O3	57,600	97,600	14.3	24.6	.08, .16, .19*	Granular; flaky streak.
			M3	52,000	95,520	12.3	18.3	.10, .18*, .09	Granular; flaky spot.
			I3	56,400	98,800	15.3	21.4	.09, .17, .20*	Do.
			O4	57,600	97,600	17.7	33.5	.20, *.18, .15	Silky, 50 per cent; granular, 50 per cent.
			M4	52,800	96,000	19.3	39.2	10, .20, .28*	Silky.
			I4	56,400	98,400	8.7	15.0	.07, .07, .12*	Granular.
			O5	55,200	98,400	16.3	18.3	.14, .21*, .14	Granular; flaky spot.
			M5	52,000	96,400	18.7	24.6	.16, .17, .23*	Do.
			I5	55,200	98,400	19.7	39.2	.12, .15, .32*	Silky.
			O6	57,200	100,000	14.3	18.3	.19*, .14, .10	Granular; silky spot.
			M6	50,800	95,200	17.3	30.6	.27*, .14, .11	Silky.
			I6	55,200	100,000	13.7	18.3	.15*, .14, .12	Granular; flaky spot.
			O8	54,000	96,000	14.3	18.3	.10, .16, .17*	Granular.
			M8	46,400	94,400	13.3	15.0	.13, .16*, .11	Do.
			I8	52,800	95,200	20.3	49.7	.11, .35*, .15	Silky.
			O10	54,400	100,400	12.3	15.0	.10, .16*, .11	Granular; flaky streak.
			M10	49,600	99,200	18.0	27.6	.23*, .19, .12	Granular, 80 per cent; silky, 20 per cent.
			I10	56,400	102,000	17.3	21.4	.14, .15, .23*	Granular; flaky streak.
			O12	54,800	99,600	12.3	18.3	.10, .13, .14*	Do.
			M12	48,000	96,000	14.3	18.3	.18*, .12, .13	Do.
			I12	56,000	101,200	16.7	44.6	.19, .23*, .08	Silky.
A_1 5388	1	Radial........	7	45,500	87,000	7.0	5.7	.06, .08*	Granular; small, silky, flaky spot.
			7	44,500	86,000	6.5	5.7	.06, .07	Granular; fractured at neck.
			7	45,000	89,100	10.5	9.5	.09, .12*	Granular; small, silky, flaky spot.
			7	45,000	89,750	10.5	9.5	.09, .12*	Do.
			7	44,500	86,900	7.5	9.5	.07, .08*	Do.
			9	48,000	87,500	5.5	5.7	.06*, .05	Do.
			9	48,500	92,100	7.0	5.7	.06, .08*	Do.
			9	48,500	94,000	8.0	9.5	.09*, .07	Do.
			9	49,000	95,500	9.5	9.5	.08, .11*	Do.
			9	48,500	91,000	6.5	5.7	.05, .08*	Do.
			9	48,500	95,100	8.5	9.5	.09*, .08	Do.
			11	48,400	89,000	4.5	5.7	.05*, .04	Do.
			11	50,000	92,800	6.5	5.7	.05, .08*	Do.

			11	48,500	92,100	6.5	5.7	.04, .09*	Do.
			11	48,000	89,900	5.5	5.7	.05, .06*	Do.
			11	48,700	89,500	5.5	5.7	.07*, .04	Do.
			11	48,400	89,900	6.0	5.7	.06*, .06	Do.
			13	47,000	84,250	4.5	5.7	.03, .06*	Do.
			13	47,000	79,800	3.5	1.8	.04*, .03	Do.
			13	48,000	93,000	7.5	9.5	.09*, .06	Do.
			13	46,500	95,000	12.5	16.9	.09, .16*	Do.
			13	48,000	79,000	3.5	5.7	.02, .05*	Do.
			13	46,500	92,600	7.5	5.7	.08, .07	Granular; fractured at neck.
A₁ 5388	2	Oblique to radial.	....	41,000	92,000	12.5	16.9	.11, .14*	Granular, 60 per cent; oblique, flaky, 40 per cent.
A₁ 5388	4	Tangential...	O1	63,200	111,600	12.3	15.0	.10, .16*, .11	Granular.
			M1	52,800	99,600	22.3	39.2	.16, .35*, .16	Granular, 30 per cent; silky, 70 per cent.
			I1	57,600	102,800	19.7	30.6	.17, .30*, .12	Silky; oblique.
			O2	62,000	111,200	10.7	11.8	.11, .12*, .09	Granular; silky spot.
			M2	53,600	104,400	17.0	30.6	.25*, .13, .13	Granular; silky center.
			I2	56,800	102,800	21.7	41.9	.14, .35*, .16	Silky; trace of granulation.
			O3	63,200	111,920	9.7	11.8	.08, .12*, .09	Granular.
			M3	52,800	103,200	16.0	36.4	.29*, .11, .08	Granular, 40 per cent; silky, 60 per cent.
			I3	48,000	102,800	18.0	39.2	.10, .13, .31*	Granular, 75 per cent; silky, 25 per cent.
			O4	59,200	108,400	18.0	30.6	.15, .26*, .13	Silky; in part granular.
			M4	49,600	98,400	21.0	39.2	.21*, .28*, .14	Silky.
			I4	57,600	104,400	20.7	44.6	.12, .29*, .21*	Do.
			O5	56,800	106,800	16.0	36.4	.10, .27*, .11	Do.
			M5	53,200	100,400	20.7	39.2	.13, .34*, .15	Do.
			I5	56,400	103,600	18.3	36.4	.13, .31*, .11	Do.
			O6	62,000	113,200	13.3	21.4	.08, .17*, .15	Granular.
			M6	52,800	102,800	19.3	36.4	.27*, .20, .11	Silky.
			I6	57,200	104,400	18.3	41.9	.27*, .18, .10	Do.
			O8	62,800	112,800	11.7	18.3	.09, .11, .15*	Granular; flaky streak.
			M8	51,200	100,800	19.0	33.5	.11, .18, .28*	Silky.
			I8	57,600	103,600	21.3	44.6	.28*, .23, .13	Do.
			O10	57,600	106,400	13.3	18.3	.15*, .14, .11	Granular; flaky streak.
			M10	51,200	100,400	17.0	30.6	.26*, .14, .11	Silky; in part granular.
			I10	55,600	100,400	19.7	41.9	.32*, .16, .11	Silky.
			O12	59,200	108,800	13.3	18.3	.11, .17*, .12	Granular; silky spot.
			M12	50,800	100,000	18.7	36.4	.24*, .22, .10	Silky.
			I12	55,200	102,800	20.7	44.6	.11, .33*, .18	Do.
A₁ 5388	4	Radial........	7	50,100	99,900	13.0	20.5	.20*, .06	Granular, 50 per cent; silky, 50 per cent.
			7	53,500	100,000	14.5	27.4	.06, .23*	Granular, 30 per cent; silky, 70 per cent.
			7	51,000	100,500	11.5	16.9	.05, .18*	Granular; silky spot.
			7	50,500	101,000	13.5	30.7	.05, .22*	Granular, 40 per cent; silky, 60 per cent.
			7	50,500	100,800	12.5	23.9	.05, .20*	Granular; silky spot.
			7	50,500	101,000	11.0	20.5	.05, .17*	Do.
			9	48,000	96,200	12.0	20.5	.06, .18*	Do.
			9	48,500	97,600	14.0	30.7	.23*, .05	Granular, 30 per cent; dull silky, 70 per cent.
			9	48,500	95,500	14.0	27.4	.05, .23*	Granular, 40 per cent; dull silky, 60 per cent.
			9	48,000	97,000	14.0	27.4	.05, .23*	Granular; silky spot.

Hoop.	Ring.	Direction.	Location.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″	
A_1 5388	4	Radial........	9	47,500	97,000	14.0	27.4	.07, .21*	Granular, 70 per cent; dull silky, 30 per cent.
			9	48,500	99,500	12.5	23.9	.05, .20*	Granular; silky spot.
			11	48,250	96,400	10.5	16.9	.06, .15*	Do.
			11	48,000	97,500	9.5	9.5	.11, .08*	Do.
			11	48,500	96,500	13.5	27.4	.20*, .07	Granular, 60 per cent; silky center, 40 per cent.
			11	48,000	98,000	12.5	23.9	.19*, .06	Granular; silky spot.
			11	47,500	96,900	11.0	16.9	.06, .16*	Do.
			11	48,500	98,200	13.5	27.4	.20*, .07	Do.
			13	49,100	98,100	14.0	23.9	.18*, .10	Do.
			13	48,200	97,600	13.5	27.4	.07, .20*	Do.
			13	48,000	97,200	12.5	20.5	.06, .19*	Do.
			13	48,000	97,800	12.0	20.5	.06, .18*	Do.
			13	48,200	97,500	15.0	30.7	.22*, .08	Granular, 50 per cent; dull silky, 50 per cent.
			13	48,500	97,600	14.5	27.4	.10, .19*	Do.
A_2 5387	1	Tangential....	O1	53,000	94,500	15.5	20.5	.16*, .15	Granular; flaky streak.
			M1	50,500	95,500	23.0	46.2	.16, .30*	Silky; trace of granulation.
			I1	57,500	97,000	23.0	49.1	.11, .35*	Silky.
			O2	52,500	96,500	12.0	13.2	.13*, .11	Granular; flaky spot.
			M2	50,500	94,500	20.0	30.7	.25*, .15	Fine granular; silky spot.
			I2	56,500	96,500	22.5	43.3	.32*, .13	Granular, 50 per cent; silky, 50 per cent.
			O3	53,500	95,000	22.0	46.2	.30*, .14	Granular, 40 per cent; silky, 60 per cent.
			M3	50,500	95,500	21.5	34.0	.29*, .14	Granular; silky, serrated spot.
			I3	57,000	97,500	18.5	23.9	.15, .22*	Granular; flaky spot.
			O4	54,000	97,000	22.5	40.3	.14, .31*	Silky.
			M4	48,000	95,500	22.0	37.1	.16, .28*	Do.
			I4	53,500	96,500	20.0	40.3	.29*, .11	Do.
			O5	54,000	99,000	22.5	46.2	.22*, .23*	Do.
			M5	49,500	97,500	21.0	40.3	.27*, .15	Do.
			I5	56,000	99,000	19.0	40.3	.10, .28*	Silky; trace of granulation.
			O6	51,000	94,500	22.5	51.9	.30*, .15	Silky.
			M6	47,000	94,000	23.0	40.3	.27*, .19	Do.
			I6	54,500	97,000	20.0	46.2	.29*, .11	Do.
			O8	53,600	100,800	13.7	15.0	.12, .15*, .14	Granular; silky spot.
			I8	54,800	99,600	19.0	41.9	.24*, .21, .12	Silky; trace of granulation.
			O10	55,600	99,600	18.0	44.6	.08, .33*, .13	Do.
			I10	50,800	97,600	17.7	36.4	.11, .16, .26*	Do.
			O12	55,200	98,000	15.3	36.4	.13, .23*, .10	Silky.
			I12	52,000	97,600	17.7	44.6	.11, .32*, .10	Silky, 50 per cent; granular, 50 per cent.
A_2 5387	1	Radial........	7	54,500	85,500	4.0	5.7	.04	Granular
			7	58,000	91,500	5.0	5.7	.05	Do.
			7	51,500	94,500	9.0	13.2	.09	Do.
			7	49,000	94,000	8.0	9.5	.08	Do.

			7	53,500	93,000	7.0	9.5	.07	Do
			7	51,500	96,000	9.0	9.5	.09	Do.
			9	53,000	92,000	7.0	9.5	.07	Do.
			9	52,500	97,500	13.0	16.9	.13	Granular; flaky spot.
			9	53,500	94,500	7.0	9.5	.07	Do.
			9	51,500	88,000	4.0	5.7	.04	Granular.
			9	52,500	91,500	4.0	5.7	.04	Do.
			9	54,000	96,500	17.0	23.9	.17	Granular, 80 per cent; silky, 20 per cent.
			11	48,500	80,500	2.0	5.7	.02	Granular; flaky streak.
			11	51,000	87,500	5.0	5.7	.05	Granular; flaky spot.
			11	53,000	90,500	5.0	9.5	.05	Granular; flaky streak.
			11	52,500	96,500	11.0	13.2	.11	Granular; flaky spot.
			11	51,500	97,000	12.0	20.5	.12	Do.
			11	53,500	89,500	5.0	5.7	.05	Do.
			13	49,000	91,000	6.0	5.7	.06	Granular; flaky streak.
			13	52,500	89,000	6.0	5.7	.06	Do.
			13	51,500	92,500	8.0	9.5	.08	Granular; flaky spot.
			13	53,000	94,000	10.0	9.5	.10	Granular.
			13	51,500	87,500	5.0	5.7	.05	Do.
			13	52,500	91,500	7.0	9.5	.07	Do.
A_2 5387	4	Tangential....	O1	54,500	94,500	13.0	16.9	.11, .15	Granular; flaky spot.
			M1	49,500	93,000	17.0	40.3	.13, .21*	Granular; flaky streak.
			I1	54,500	96,500	21.0	43.3	.16, .26*	Silky.
			O2	56,000	95,000	26.5	51.9	.29*, .24*	Do.
			M2	49,000	93,000	24.5	46.2	.35*, .14	Do.
			I2	54,000	94,500	19.5	43.3	.09, .30*	Silky, 50 per cent; granular, 50 per cent.
			O3	54,500	98,000	12.0	16.9	.09, .15*	Granular; flaky spot.
			M3	50,000	95,500	18.5	20.5	.22*, .15	Do.
			I3	56,000	97,500	21.5	46.2	.10, .33*	Silky.
			O4	53,500	95,500	18.5	20.5	.17*, .20	Granular; flaky spot.
			M4	52,000	96,000	23.0	43.3	.23*, .23*	Silky.
			I4	57,500	99,000	22.0	51.9	.30*, .14	Do.
			O5	55,000	99,500	15.5	20.5	.14, .17*	Granular; flaky streak.
			M5	51,500	96,500	21.0	34.0	.16*, .26*	Granular; silky spot.
			I5	57,000	99,500	22.0	49.1	.32*, .12	Silky.
			O6	54,000	99,000	14.0	20.5	.16*, .12	Granular; flaky streak.
			M6	51,000	96,500	22.5	37.5	.15, .30*	Silky.
			I6	54,000	99,500	22.0	46.2	.29*, .15	Do.
			O8	56,400	100,400	15.7	27.6	.26*, .12, .09	Granular; flaky streak.
			I8	54,000	98,000	18.7	39.2	.11, .13, .32*	Granular, 60 per cent; silky, 40 per cent.
			O10	56,400	100,800	11.0	11.8	.11, .12*, .10	Granular; flaky streak.
			I10	53,600	98,800	19.7	39.2	.13, .33*, .13	Granular, 40 per cent; silky, 60 per cent.
			O12	53,200	98,000	10.7	11.8	.13*, .10, .09	Granular; flaky streak.
			I12	54,400	99,600	16.7	21.4	23*, .13, .14	Granular, 40 per cent; flaky, 60 per cent.
A_2 5387	4	Radial........	7	50,500	92,000	9.0	9.5	.09	Granular; flaky streak.
			7	52,500	94,500	8.0	9.5	.08	Granular.
			7	49,500	88,000	6.0	9.5	.06	Do.
			7	49,500	89,500	6.0	5.7	.06	Do.
			7	51,500	88,000	6.0	5.7	.06	Do.
			7	49,000	94,000	10.0	9.5	.10	Do.

Hoop.	Ring.	Direction.	Location.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
A_2 5387	1	Radial........	9	52,500	77,500	2.0	1.8	.02	Granular; fractured at neck.
			9	53,000	90,500	5.0	9.5	.05	Granular.
			9	51,000	96,000	6.0	5.7	.06	Do.
			9	55,000	82,500	4.0	5.7	.04	Do.
			9	50,500	96,500	18.0	23.9	.18	Granular; silky spot.
			9	53,000	98,000	7.0	9.5	.07	Granular.
			11	....	88,500	5.0	9.5	.05	Granular; flaky streak.
			11	55,000	93,000	5.0	5.7	.05	Granular; fractured at neck.
			11	52,500	87,000	4.0	5.7	.04	Granular.
			11	50,500	95,500	7.0	9.5	.07	Do.
			11	51,000	91,000	6.0	9.5	.06	Granular; flaky streak.
			11	53,000	93,000	8.0	13.2	.08	Granular.
			13	55,000	95,500	8.0	1.8	.08	Granular; fractured at neck.
			13	54,000	92,000	6.0	5.7	.06	Granular.
			13	50,500	95,000	9.0	9.5	.09	Do.
			13	50,000	98,500	15.0	16.9	.15	Do.
			13	52,000	82,500	5.0	5.7	.05	Do.
			13	50,000	95,000	11.0	9.5	.11	Granular; flaky streak.
B 2827	1	Tangential....	O1	52,400	95,600	22.3	49.7	.13, .40*, .14	Silky, oblique.
			M1	49,200	94,000	21.7	44.6	.20, .30*, .15	Silky; trace of granulation
			I1	55,600	99,200	17.7	49.7	.32*, .11, .10	Silky.
			O2	53,200	96,400	18.7	39.2	.10, .33*, .13	Do.
			M2	48,800	93,200	19.7	44.6	.24*, .24*, .11	Silky; trace of granulation.
			I2	57,200	100,400	18.3	39.2	.30*, .14, .11	Silky, 40 per cent; granular, 60 per cent.
			O3	53,600	96,400	19.3	49.7	.08, .34*, .16	Silky.
			M3	49,200	95,200	19.0	21.4	.12, .17, .28*	Granular; silky spot.
			I3	60,000	102,800	17.7	39.2	.31*, .11, .11	Do.
			O4	53,600	96,800	20.7	21.4	.10, .21*, .31	Do.
			M4	52,000	96,000	19.7	49.7	.11, .13, .35*	Silky.
			I4	49,600	93,600	20.3	47.2	.33*, .15, .13	Do.
			O5	52,000	94,800	16.7	21.4	.23*, .16, .11	Granular: flaky spot.
			M5	49,600	94,000	19.0	44.6	.12, .15, .30*	Silky; trace of granulation.
			I5	53,600	98,400	21.3	44.6	.34*, .16, .14	Do.
			O6	53,600	95,200	22.0	47.2	.12, .38*, .16	Silky.
			M6	50,000	92,000	20.7	44.6	.15, .36*, .11	Silky; trace of granulation.
			I6	50,800	94,000	22.0	49.7	.14, .18, .34*	Silky.
			O8	52,400	95,600	22.3	49.7	.15, .37*, .15	Do.
			M8	50,400	95,600	19.3	36.4	.18, .30*, .10	Silky; trace of granulation.
			I8	53,600	98,800	17.0	44.6	.11, .32*, .08	Do.
			O9	49,600	90,800	22.7	54.6	.15, .41*, .12	Silky.
			M9	48,000	91,200	20.3	41.9	.11, .27*, .23	Silky; trace of granulation.
			I9	52,800	95,200	19.3	41.9	.10, .15, .33*	Silky, 40 per cent; granular, 60 per cent.

B 2827	1	Radial........	O10	49,200	88,800	23.0	52.2	.13, .39*, .17	Silky.
			M10	46,000	88,000	23.0	47.2	.25, .29*, .15	Do.
			I10	51,600	93,600	19.3	49.7	.31*, .10, .17	Silky; trace of granulation.
			O12	49,200	90,800	21.0	39.2	.12, .26, .25*	Silky.
			M12	46,000	90,000	23.0	47.2	.37*, .18, .14	Do.
			I12	51,600	94,000	18.0	47.2	.10, .09, .35*	Silky; trace of granulation.
			O14	48,800	88,800	22.7	54.6	.39*, .17, .12	Silky.
			M14	46,000	87,600	21.7	47.2	.18, .33*, .14	Silky; trace of granulation.
			I14	50,000	90,800	20.3	49.7	.10, .16, .35*	Silky.
			O15	49,200	87,600	23.0	52.2	.15, .42*, .12	Do.
			M15	45,600	87,200	23.3	49.7	.16, .18, .36*	Do.
			I15	49,200	90,800	24.7	49.7	.25, .29*, .20	Do.
			7	50,100	96,000	13.0	16.9	.13*, .13	Granular.
			7	50,300	96,000	10.0	9.5	.09, .11*	Do.
			7	50,000	93,500	8.5	5.7	.08, .09	Granular; fractured at neck.
			7	49,500	94,900	17.5	37.1	.18*, .17*	Silky.
			7	49,500	94,500	11.0	13.2	.10, .12*	Granular.
			7	49,300	95,100	10.0	9.5	.10, .10*	Do.
			11	46,200	88,800	13.5	16.9	.13, .14*	Do.
			11	46,000	89,900	19.5	13.2	.23*, .16	Silky, 60 per cent; granular, 40 per cent.
			11	45,900	88,900	19.0	20.5	.17, .21*	Granular; silky spot.
			11	46,500	89,500	11.5	13.2	.10, .13*	Granular.
			11	45,600	89,500	16.5	23.9	.15, .18*	Do.
			11	46,000	89,800	16.5	23.9	.15, .18*	Granular; silky spot.
			13	45,100	88,700	15.5	23.9	.13, .18*	Granular.
			13	45,500	89,300	13.5	13.2	.14*, .13	Do.
			13	46,500	89,800	16.0	20.5	.18*, .14	Do.
			13	45,200	87,600	11.5	16.9	.13*, .10*	Granular; silky spot.
			13	46,700	88,200	17.0	16.9	.17, .17*	Granular.
			13	45,500	87,800	15.0	16.9	.15, .15*	Do.
			16	48,000	89,400	10.0	13.2	.07, .13*	Do.
			16	47,000	84,000	6.5	9.5	.05, .08*	Do.
			16	47,600	90,300	14.0	16.9	.11, .17*	Do.
			16	47,400	90,500	11.0	13.2	.09, .13*	Do.
			16	47,000	89,500	11.5	13.2	.09, .14*	Do.
			16	47,500	90,500	13.5	16.9	.10, .17*	Do.
B 2827	2	Radial........	(a)	48,800	96,800	17.0	47.2	.32*, .11, .08	Silky.
			(a)	50,000	100,000	16.7	41.9	.08, .29*, .13	Do.
			(a)	50,400	97,600	19.7	41.9	.08, .32*, .19	Do.
B 2827	4	Tangential...	O1	52,800	94,800	22.7	47.2	.15, .23, .30*	.Do.
			M1	49,200	93,200	20.0	41.9	.12, .33*, .15	Do.
			I1	55,200	99,600	16.7	36.4	.28*, .12, .10	Silky, 30 per cent; granular, 70 per cent.
			O1	50,000	94,000	20.7	49.7	.22, .30*, .10	Silky.
			M1	47,200	92,000	19.3	47.2	.35*, .13, .10	Do.
			I1	54,400	99,200	21.0	41.9	.15, .33*, .15	Silky; trace of granulation.
			O2	52,400	94,000	21.0	49.7	.14, .36*, .13	Silky.
			M2	50,400	92,800	18.0	27.6	.10, .28*, .16	Granular; silky, serrated spot.

[a] Drawn down from square pieces in arsenal shop.

Hoop	Ring.	Direction.	Location.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
B 2827	4	Tangential ...	I2	55,600	98,000	19.3	39.2	.26*, .21, .11	Granular; silky spot.
			O3	46,000	90,400	21.0	52.2	.38*, .14, .11	Silky.
			M3	45,600	89,600	22.0	47.2	.35*, .16, .15	Do.
			I3	51,600	94,000	20.3	49.7	.15, .35*, .11	Do.
			O4	48,000	86,400	24.0	54.6	.35*, .22, .15	Do.
			M4	44,800	86,800	21.3	49.7	.13, .25*, .26*	Silky; trace of granulation.
			I4	48,400	90,400	20.7	49.7	.13, .12, .37*	Silky.
			O5	47,200	87,200	22.0	57.0	.12, .42*, .12	Do.
			M5	46,000	87,600	21.3	54.6	.12, .40*, .12	Do.
			I5	48,800	91,600	20.0	49.7	.14, .37*, .09	Do.
			O6	49,600	89,600	21.3	54.6	.10, .16, .38*	Do.
			M6	45,600	88,000	22.0	39.2	.12, .32*, .22	Silky, 50 per cent; granular, 50 per cent.
			I6	48,770	90,980	21.0	45.9	.12, .38*, .13	Silky.
			O8	50,800	91,200	16.0	18.3	.11, .14, .23*	Granular.
			M8	45,600	90,800	18.3	30.6	.24*, .18, .13	Granular; silky spot.
			I8	52,000	93,600	21.0	47.2	.21, .29*, .13	Silky; trace of granulation.
			O9	49,200	93,600	20.7	49.7	.29*, .22, .11	Silky.
			M9	47,200	92,400	20.0	41.9	.37*, .12, .11	Do.
			I9	52,400	97,200	19.3	47.2	.09, .34*, .15	Do.
			O12	49,600	93,200	20.0	47.2	.12, .36*, .12	Do.
			M12	47,600	93,200	20.7	39.2	.18, .30*, .14	Do.
			I12	54,000	97,600	20.3	39.2	.16, .20, .25*	Silky; trace of granulation.
			O14	51,200	92,000	22.0	49.7	.15, .38*, .13	Silky.
			M14	46,000	92,000	20.3	41.9	.34*, .14, .13	Silky, 30 per cent; granular, 70 per cent.
			I14	53,600	94,400	18.0	36.4	.10, .13, .31*	Silky, 25 per cent; granular, 75 per cent.
			O15	50,400	89,200	20.7	49.7	.11, .12, .39*	Silky.
			M15	45,600	89,200	21.3	44.6	.14, .33*, .17	Do.
			I15	50,800	92,800	21.0	36.4	.28*, .20, .15	Silky, 30 per cent; granular, 70 per cent.
B 2827	4	Radial........	7	46,000	88,000	8.0	5.7	.07, .09*	Granular.
			7	46,000	89,900	15.5	20.5	.10, .21*	Granular; silky spot.
			7	46,500	91,000	11.0	13.2	.08, .14*	Granular.
			7	46,500	90,100	14.5	20.5	.10, .19*	Do.
			7	46,000	87,500	7.0	9.5	.05, .09*	Do.
			7	45,500	89,000	9.5	9.5	.07, .12*	Do.
			11	47,500	92,500	10.0	9.5	.10*, .10*	Do.
			11	47,000	92,600	17.5	30.7	.12, .23*	Silky and granular.
			11	48,000	93,500	14.0	16.9	.13, .15*	Granular.
			11	46,500	91,500	8.5	9.5	.07, .10*	Do.
			11	46,500	91,000	9.5	9.5	.08, .11*	Do.
			11	47,000	92,500	17.5	20.5	.14, .21*	Do.
			13	46,500	92,500	14.0	16.9	.12, .14*	Do.
			13	47,500	92,900	10.5	9.5	.10, .11*	Do.

			13	47,500	92,500	10.0	9.5	.10*, .10	Do.
			13	48,500	91,250	9.5	5.7	.09, .10*	Do.
			13	48,000	87,000	5.5	5.7	.05, .06*	Do.
			13	47,000	92,500	10.0	9.5	.08, .12*	Do.
			16	46,500	89,000	13.0	13.2	.16*, .10	Do.
			16	46,500	85,500	7.0	9.5	.06, .08*	Do.
			16	48,500	88,000	8.5	9.5	.08, .09*	Do.
			16	46,500	89,000	13.5	13.2	.16*, .11	Do.
			16	46,500	89,000	12.5	13.2	.14*, .11	Do.
			16	46,000	88,000	9.0	9.5	.09, .09*	Do.
B 2837	1	Tangential...	O1	60,800	104,400	18.7	49.7	.34*, .12, .10	Silky.
			M1	54,800	101,200	18.7	44.6	.13, .12, .31*	Do.
			I1	68,800	109,600	17.3	41.9	.13, .16, .23*	Do.
			O2	61,800	104,400	17.0	47.2	.10, .32*, .09	Do.
			M2	54,800	101,200	15.3	30.6	.17, .18*, .11	Silky, 25 per cent; granular, 75 per cent.
			I2	66,800	109,600	16.0	44.6	.18, .20*, .10	Silky.
			O3	62,000	104,400	18.0	39.2	.14, .30*, .10	Silky; trace of granulation.
			M3	53,600	99,600	17.0	47.2	.12, .31*, .08	Silky.
			I3	64,400	107,200	16.0	47.2	.13, .27*, .08	Do.
			O4	59,600	102,400	21.3	41.9	.11, .19, .34*	Do.
			M4	52,800	98,400	16.7	41.9	.22*, .17, .11	Granular; silky center.
			I4	64,400	106,000	15.3	41.9	.09, .08, .29*	Do.
			O5	58,800	99,600	21.7	49.7	.34*, .18, .13	Silky.
			M5	52,650	95,920	19.0	40.7	.10, .17, .30*	Fine granular; silky center.
			I5	63,600	103,360	15.3	30.6	.09, .14, .23*	Fine granular; silky spot.
			O6	57,200	95,960	19.7	49.7	.09, .37*, .13	Silky.
			M6	53,200	94,800	18.3	41.9	.14, .32*, .09	Silky; trace of granulation.
			I6	63,600	99,600	16.7	47.2	.34*, .09, .07	Silky.
			O7	54,800	91,200	19.3	30.6	.13, .29*, .16	Fine granular; silky spot.
			M7	52,000	91,920	19.7	49.7	.10, .36*, .13	Silky.
			I7	60,800	96,800	19.7	52.2	.31*, .19, .09	Do.
			O8	55,200	90,400	22.0	52.2	.12, .22, .32*	Do.
			M8	50,400	90,000	19.3	49.7	.09, .36*, .13	Do.
			I8	59,200	94,800	19.0	49.7	.34*, .14, .09	Do.
			O9	55,600	90,800	23.0	52.2	.17, .15, .37*	Do.
			M9	50,000	90,720	20.0	47.2	.10, .14, .36*	Silky; trace of granulation.
			I9	59,920	95,600	20.3	54.6	.12, .30*, .19	Silky.
			O10	55,120	92,080	21.3	47.2	.36*, .16, .12	Do.
			M10	51,040	91,200	20.7	47.2	.12, .36*, .14	Do.
			I10	59,200	96,800	21.0	47.2	.36*, .13, .14	Silky; trace of granulation.
			O11	55,920	91,020	20.3	40.7	.16, .13, .32*	Granular, 70 per cent; silky, 30 per cent.
			M11	51,200	91,120	21.7	47.2	.36*, .17, .12	Silky.
			I11	60,400	96,000	19.3	49.7	.09, .37*, .12	Do.
			O12	53,600	87,120	23.0	52.2	.10, .19, .40*	Do.
			M12	49,600	90,000	22.0	47.2	.11, .26*, .29*	Silky; trace of granulation.
			I12	60,000	95,200	18.0	47.2	.10, .34*, .10	Silky.
			O13	54,000	88,400	20.7	54.0	.38*, .12, .12	Do.
			M13	49,600	88,720	21.0	49.7	.11, .33*, .19	Silky; trace of granulation.
			I13	60,000	95,600	18.7	44.6	.32*, .13, .11	Do.
			O14	55,600	92,400	11.7	15.0	.17*, .10, .08	Granular; flaky spot.
			M14	52,000	92,720	19.0	30.6	.25*, .23, .09	Granular, 90 per cent; flaky, 10 per cent.

Hoop.	Ring.	Direction.	Location.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
B 2837	1	Tangential...	I14	60,800	97,200	13.7	27.6	.07, .12, .22*	Granular; flaky spot.
			O15	57,600	96,800	10.7	15.0	.09, .09, .14*	Granular.
			M15	53,600	95,600	18.0	41.9	.09, .31*, .14	Granular; silky center.
			I15	64,720	101,200	18.3	49.7	.10, .14, .31*	Silky.
			O16	59,920	99,600	17.3	44.6	.09, .32*, .11	Silky; trace of granulation.
			M16	54,400	97,400	17.3	41.9	.32*, .09, .11	Silky, 50 per cent; granular, 50 per cent.
			I16	66,000	104,800	17.3	39.2	.18, .24*, .10	Silky, 60 per cent; granular, 40 per cent.
B 2837	2	Tangential...	I	59,000	100,850	20.0	46.2	.10, .30*	Silky.
			M	53,500	96,500	20.5	49.1	.14, .27*	Do.
			O	58,000	98,800	21.5	51.9	.11, .32*	Do.
B 2837	2	Radial........	R	53,000	99,300	12.0	20.5	.10, .14*	Granular; silky line.
			R	54,000	95,150	9.0	9.5	.07, .11*	Granular.
			R	54,500	87,850	4.0	1.8	.03, .05*	Do.
			R	51,000	89,950	6.0	5.7	.05, .07*	Do.
			R	52,500	86,300	4.0	5.7	.03*, .05	Do.
			R	59,500	88,900	4.0	5.7	.04*, .04	Do.
B 2837	5	Tangential...	O1	61,200	102,000	18.3	47.2	.33*, .11, .11	Silky, oblique.
			M1	59,200	103,000	18.7	44.6	.11, .16, .29*	Silky.
			I1	64,560	105,320	16.0	49.6	.32*, .09, .07	Do.
			O2	63,600	104,080	17.7	47.2	.10, .32*, .11	Do.
			M2	62,400	104,400	18.3	44.6	.11, .33*, .11	Do.
			I2	66,000	106,000	15.7	44.6	.28*, .12, .07	Do.
			O3	65,600	104,800	18.7	47.2	.32*, .12, .12	Do.
			M3	64,400	104,200	18.3	49.7	.11, .34*, .10	Do.
			I3	66,000	105,200	15.3	49.7	.07, .28*, .11	Do.
			O4	65,600	103,200	15.0	36.4	.28*, .09, .08	Fine granular; flaky streak.
			M4	64,400	101,600	16.7	47.2	.28*, .15, .07	Silky.
			I4	67,200	103,600	16.0	47.2	.07, .12, .29*	Do.
			O5	64,800	103,200	17.7	44.6	.11, .31*, .11	Granular; silky center.
			M5	63,200	101,600	16.0	44.6	.25*, .15, .08	Granular, 40 per cent; silky, 60 per cent.
			I5	65,200	103,200	10.0	11.8	.11, .09, .10*	Granular; flaky spot.
			O6	61,630	101,220	15.3	19.8	.17, .19*, .10	Granular.
			M6	60,000	99,600	15.3	36.4	.08, .29*, .09	Granular; flaky spot.
			I6	63,600	102,400	17.0	39.2	.13, .29*, .09	Silky; trace of granulation.
			O7	59,200	96,800	16.3	30.6	.08, .25*, .16	Granular; silky, serrated spot.
			M7	55,600	96,000	10.3	11.8	.09, .10, .12*	Granular; flaky streak.
			I7	61,600	100,400	15.7	47.2	.32*, .08, .07	Silky; trace of granulation.
			O8	55,600	93,200	15.0	21.4	.23*, .13, .09	Granular; flaky spot.
			M8	52,800	92,800	18.3	47.2	.10, .31*, .14	Silky; trace of granulation.
			I8	60,800	96,800	17.3	49.7	.28*, .16, .08	Silky.
			O9	54,400	90,400	22.3	52.2	.20, .29*, .08	Do.

			M9	54,000	86,880	5.3	5.0	.06*, .05, .05	Granular; silky, serrated spot.
			I9	60,800	94,400	18.7	49.7	.08, .26*, .22	Silky.
			O10	58,000	90,000	20.7	52.2	.12, .39*, .11	Do.
			M10	57,480	91,200	19.0	44.6	.11, .14, .32*	Do.
			I10	62,000	96,720	18.3	49.7	.35*, .11, .09	Silky, 85 per cent; granular, 15 per cent.
			O11	54,800	92,320	20.7	44.6	.14, .33*, .15	Silky; trace of granulation.
			M11	50,400	90,800	19.3	47.2	.11, .37*, .10	Do.
			I11	60,400	95,840	12.0	11.8	.09, .13, .14	Granular; silky, serrated spot.
			O12	57,200	75,600	3.0	5.0	.03, .02, .04	Granular; flaky streak.
			M12	50,800	90,400	17.3	18.3	.12, .19, .21*	Granular.
			I12	58,000	94,400	20.3	47.2	.12, .37*, .12	Silky.
			O13	55,920	89,200	19.3	36.4	.14, .30*, .14	Granular, 80 per cent; silky, 20 per cent.
			M13	50,400	88,800	20.7	44.6	.15, .33*, .14	Silky; trace of granulation.
			I13	56,800	92,400	8.0	11.8	.08, .07, .09*	Granular; flaky streak.
			O14	56,000	90,000	20.0	52.2	.37*, .13, .10	Silky.
			M14	54,400	91,600	21.7	49.7	.33*, .18, .14	Do.
			I14	59,200	94,800	19.3	52.2	.13, .34*, .11	Do.
			O15	58,800	93,520	17.3	33.5	.26*, .16, .10	Granular; silky, serrated spot.
			M15	58,000	94,800	20.7	49.7	.23, .27*, .12	Silky.
			I15	60,800	96,400	19.7	54.6	.11, .36*, .12	Do.
			O16	59,600	97,600	18.7	49.7	.10, .34*, .12	Do.
			M16	56,800	97,200	18.3	44.6	.11, .12, .32*	Granular, 50 per cent; silky, 50 per cent.
			I16	62,400	99,600	18.0	47.2	.10, .11, .33*	Silky; trace of granulation.
B 2855	1	Tangential...	O1	58,000	103,600	11.7	11.8	.13*, .13, .09	Granular
			M1	51,600	98,800	15.3	44.6	.25*, .11, .10	Granular; silky spot.
			I1	59,600	103.200	16.7	44.6	.08, .30*, .12	Fine granular, 50 per cent; silky, 50 per cent.
			O2	58,800	103,600	16.0	36.4	.09, .28*, .11	Granular, silky center.
			M2	52,400	99,200	16.0	36.4	.08, .31*, .09	Do.
			I2	62,400	106,800	16.0	30.6	.24*, .11, .13	Granular, 85 per cent; silky, 15 per cent.
			O3	56,800	98,800	11.7	15.0	.08, .15*, .12	Granular; silky spot.
			M3	50,400	96,800	15.7	24.6	.21*, .14, .12	Do.
			I3	58,800	100,000	17.3	47.2	.08, .17, .27*	Silky; trace of granulation.
			O4	60,000	107,200	17.7	44.6	.10, .27*, .16	Silky.
			M4	52,800	103,200	16.0	36.4	.26*, .10, .12	Granular; silky center.
			I4	60,800	106,400	21.5	41.9	.28*, .07, .08	Do.
			O5	61,600	107,200	10.0	11.8	.10, .10*, .10*	Granular.
			M5	54,800	105,200	15.7	27.6	.14, .23*, .10	Granular; silky spot.
			I5	64,400	110,000	17.3	39.2	.28*, .13, .11	Granular; silky center.
			O6	60,800	106,400	9.3	11.8	.10, .08, .10*	Granular; silky spot.
			M6	56,000	105,200	17.0	33.5	.09, .26*, .16	Granular; 90 per cent; silky, 10 per cent.
			I6	61,200	105,200	15.3	39.2	.26*, .12, .08	Granular; silky center.
			O7	62,000	106,400	13.3	18.3	.16*, .15, .09	Granular; flaky spot.
			M7	53,200	102,800	12.3	11.8	.09, .17, .11*	Granular.
			I7	62,000	107,200	16.0	36.4	.23*, .15, .10	Granular; silky center.
			O8	55,600	96,400	17.3	30.6	.10, .12, .30*	Granular; silky spot.
			M8	49,600	93,200	18.7	41.9	.25*, .22, .09	Granular; silky center.
			I8	58,000	98,400	18.0	44.6	.33*, .13, .08	Silky; trace of granulation.
			O9	51,600	92,400	18.3	27.6	.11, .20, .24*	Granular; flaky spot.
			M9	45,600	92,000	21.3	44.6	.19, .31*, .14	Granular, 40 per cent; silky, 60 per cent.
			I9	52,400	94,800	19.0	47.2	.25*, .23*, .09	Silky.
			O10	53,200	93,600	18.3	30.6	.09, .18, .28*	Granular; silky spot.

Hoop.	Ring.	Direction.	Location.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
B 2855	1	Tangential...	M10	46,400	92,400	20.7	36.4	.12, .18, .32*	Granular; silky spot.
			I10	55,000	98,500	20.5	34.0	.28*, .13	Do.
			O11	55,200	96,800	15.3	21.4	.21*, .15, .10	Granular.
			M11	48,000	94,400	20.3	36.4	.13, .16, .32*	Granular. 60 per cent; silky, 40 per cent.
			I11	57,600	100,400	19.3	44.6	.15, .31*, .12	Silky; trace of granuation.
			O12	55,200	96,400	8.7	8.4	.07, .11*, .08	Granular.
			M12	50,000	96,800	19.3	41.9	.14, .13, .31*	Granular, 40 per cent; silky, 60 per cent.
			I12	58,000	101,500	20.0	46.2	.12, .28*	Silky.
			O13	54,000	97,080	19.0	47.5	.33*, .13, .11	Do.
			M13	49,600	95,200	18.3	39.2	.12, .12, .31*	Granular, 60 per cent; silky, 40 per cent.
			I13	58,400	100,800	18.0	47.2	.09, .15, .30*	Silky.
			O14	54,800	98,800	15.0	21.4	.09, .14, .22*	Granular; silky spot.
			M14	49,200	95,600	17.3	39.2	.19, .24*, .09	Granular, 70 per cent; silky, 30 per cent.
			I14	56,000	98,000	17.3	33.5	.11, .15, .26*	Granular; silky spot.
			O15	60,000	106,800	14.0	18.3	.17*, .14, .11	Granular.
			M15	54,400	104,400	16.7	36.4	.17, .23*, .10	Silky and granular.
			I15	61,000	108,000	18.0	43.3	.28*, .08	Silky.
			O16	58,000	100,400	7.7	8.4	.09*, .07, .07	Granular; silky spot.
			M16	50,000	100,400	16.3	39.2	.30*, .10, .09	Silky.
			I16	59,600	105,600	16.7	27.6	.10, .19*, .21*	Granular; silky spot.
B 2855	4	Tangential...	O1	59,200	101,600	18.7	39.2	.29*, .15, .12	Fine granular, 85 per cent; silky, 15 per cent.
			M1	54,800	97,200	17.0	41.9	.21*, .21*, .19	Silky.
			I1	56,800	99,600	19.0	41.9	.30*, .13, .14	Do.
			O2	58,400	102,800	17.7	21.4	.11, .29*, .13	Granular; flaky streak.
			M2	53,200	97,200	18.7	41.9	.10, .15, .31*	Fine granular; silky center.
			I2	55,600	98,800	18.7	44.6	.31*, .13, .12	Silky; trace of granulation.
			O3	57,200	98,400	19.0	44.6	.08, .17, .32*	Do.
			M3	54,400	97,200	18.3	44.6	.16, .28*, .11	Do.
			I3	55,920	98,400	20.0	47.2	.26*, .24, .10	Silky.
			O4	55,200	94,400	19.7	52.2	.36*, .14, .09	Do.
			M4	52,400	96,400	19.7	47.2	.33*, .12, .14	Do.
			I4	58,000	97,200	16.7	49.7	.05, .09, .36*	Do.
			O5	51,200	91,200	20.0	52.2	.11, .38*, .11	Do.
			M5	48,000	91,200	16.7	30.6	.11, .18, .21*	Granular, 50 per cent; silky, 50 per cent.
			I5	50,400	93,200	20.3	44.6	.23*, .25*, .13	Silky.
			O6	50,800	90,800	20.7	52.2	.10, .37*, .15	Do.
			M6	47,200	89,600	19.3	49.7	.12, .35*, .11	Do.
			I6	51,200	92,800	18.0	44.6	.32*, .12, .10	Do.
			O8	52,000	92,400	21.0	49.7	.35*, .13, .15	Do.
			M8	46,400	75,200	3.7	5.0	.05*, .03, .03	Granular; flaky streak.
			I8	49,200	88,000	21.3	47.2	.13, .38*, .13	Silky.
			O9	60,400	102,800	17.0	24.6	.14, .16, .21*	Granular; silky spot.
			M9	53,600	96,400	18.3	41.9	.16, .29*, .10	Silky.

			I9	56,000	99,200	12.7	24.6	.20*, .10, .08	Granular; silky spot.
			O10	57,600	102,400	18.7	36.4	.11, .33*, .12	Silky; trace of granulation.
			M10	54,800	100,400	20.0	41.9	.13, .15, .32*	Silky.
			I10	56,400	103,600	15.3	41.9	.28*, .10, .08	Do.
			O12	58,400	102,400	16.0	21.4	.12, .19*, .17	Granular, 60 per cent; oblique flaky, 40 per cent.
			M12	53,600	96,800	14.0	21.4	.20*, .12, .10	Granular, 50 per cent; oblique flaky, 50 per cent.
			I12	54,800	100,800	13.0	18.3	.15*, .12, .12	Granular; flaky spot.
			O14	54,000	95,600	14.3	18.3	.11, .13, .19*	Do.
			M14	50,400	92,800	15.7	21.4	.10, .24*, .13	Do.
			I14	53,600	96,000	20.0	49.7	.37*, .14, .19	Silky.
			O16	51,600	91,600	21.0	41.9	.14, .37*, .12	Do.
			M16	48,400	88,400	10.7	15.0	.13*, .08, .11	Granular; flaky streak.
			I16	50,800	94,800	11.0	11.8	.11, .12*, .10	Granular; flaky spot.
B 2855	4	Radial........	7	46,500	69,500	2.5	5.7	.02, .03*	Do.
			7	58,500	81,000	5.0	1.8	.06*, .04	Granular.
			7	46,500	85,000	7.0	9.5	.06, .08*	Do.
			7	46,000	75,000	3.5	5.7	.05*, .02	Do.
			7	49,000	84,000	5.5	5.7	.06*, .05	Do.
			7	46,000	83,500	6.0	5.7	.06, .06*	Do.
			11	51,000	82,000	4.0	5.7	.04*, .04	Do.
			11	51,000	82,000	2.5	1.8	.02, .03*	Granular; flaky streak.
			11	51,000	95,000	9.0	13.2	.06, .12*	Granular; flaky spot.
			11	50,500	88,500	5.0	5.7	.03, .07*	Granular.
			11	51,000	90,000	5.5	5.7	.05, .06*	Granular; flaky streak.
			11	51,000	90,500	5.0	5.7	.04, .06*	Granular.
			13	48,000	79,000	3.5	5.7	.03, .04*	Do.
			13	49,500	85,500	5.0	5.7	.05. .05	Do.
			13	49,000	85,500	5.0	5.7	.06*, .04	Do.
			13	48.500	91,500	7.0	9.5	.08*, .06	Granular; flaky spot.
			13	49,000	80,000	4.0	5.7	.04, .04	Granular.
			13	48,000	91,000	10.0	16.9	.06, .14	Granular; flaky spot.

CHEMICAL ANALYSES.

Hoop.	Specimen.	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
2837	1M7	.440	.800	.259	.024	.029
2837	1I7	.450	.800	.257	.023	.028
2837	1O8	.450	.800	.255	.024	.028
2837	5M9	.470	.770	.250	.023	.032
2837	5O12	.480	.770	.250	.024	.030

MANDREL TESTS OF RINGS FROM GUN HOOPS.

MANDREL TESTS.

Rings forced over cast-iron mandrels having a taper of ".04 per inch. Interior diameter of rings bored to the taper of the mandrels. Black lead and tallow used as a lubricant.

Marks.	Dimensions.				Maximum circumferential expansion at bore.		Remarks.
	Interior diameter.	Interior circumference.	Exterior diameter.	Length.			
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Per ct.*	
2843-2	28.08	88.22	36.13	1.53	3.08	3.5	Ring fractured. Appearance, granular, radiating from a point at the exterior circumference.
2843-3	28.02	88.02	35.14	1.54	4.63	5.3	Do.
5387-2	28.08	88.22	33.60	1.54	7.98	9.0	Ring fractured. Appearance, granular, radiating from rear corner, inside edge of the ring.
5387-3	28.08	88.22	33.61	1.54	6.98	7.9	Ring fractured. Appearance, granular, radiating from a silky, flaky spot ".3 by ".3 at the outside corner of the ring.
5388-2	28.08	88.22	36.06	1.49	9.39	10.6	Ring not fractured.
5388-3	28.08	88.22	35.00	1.51	9.39	10.6	Do.

No. 7805.

TANGENTIAL SPECIMENS TAKEN FROM RING FROM OUTSIDE PORTION OF STREAKED HOOP NO. 23218 B_2.

First specimen.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	....	
20,000	.0020	....	
30,000	.0030	....	
40,000	.0040	....	
50,000	.0051	0.	
55,000	.0054	....	
60,000	.0061	0.	Elastic limit.
61,000	.0080	....	
62,000	.0270	....	
63,000	.0295	....	
64.000	.0328	....	
66,000	.0380	....	
68,000	.0430	....	
70,000	.0471	....	
72,000	.0530	....	
76,000	.08−	....	
80,000	.08+	....	
84,000	.10	....	
88,000	.12	....	
92,000	.14	....	
96,000	.19	....	
100,000	.29	....	
102,080	....	....	Tensile strength.
0	.66	....	=22 per cent.

Elongation of inch sections, ".36*, ".17, ".13.
Diameter at fracture, ".40; area, .1257 square inch.
Contraction of area, 49.7 per cent.
Appearance of fracture, fine silky, cup-shaped.

No. 7806.

Second specimen.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	....	
20,000	.0021	....	
30,000	.0031	....	
40,000	.0042	....	
50,000	.0052	0.	
55,000	.0059	....	
59,000	.0063	....	Elastic limit.
60,000	.0235	....	
61,000	.0255	....	
62,000	.0202	....	
64,000	.0340	....	
66,000	.0390	....	
68,000	.0438	....	
70,000	.0490	....	
72,000	.0550	....	
76,000	.07	....	
80,000	.08	....	
84,000	.10	....	
88,000	.12	....	
92,000	.15	....	
96,000	.20	....	
100,000	.29	....	
101,200	....	....	Tensile strength.
0	.62	....	=20.7 per cent.

Elongation of inch sections, ″.12, ″.38*, ″.12.
Diameter at fracture, ″.39; area, .1194 square inch.
Contraction of area, 52.2 per cent.
Appearance of fracture, fine silky, cup-shaped.

GUN WIRE.

GUN WIRE TESTED FOR SPRINGFIELD ARMORY, MASS.

Wire furnished by the John A. Roebling's Sons Company, Trenton, N. J.

The elongations of the samples were measured on a gauged length of 10 inches, with increments of loads of 10,000 pounds per square inch.

No well-defined elastic limits are shown. Permanent sets were developed under early loads, which gradually increased as the loads of tension were advanced.

When received the wires were coiled, the free diameters of which are given in the details of the tests. They were straightened with a mallet, thereby introducing additional internal strains over those present in the coil.

By reason of the internal strains the different parts of the wire would successively reach a state of overstrain. Near the close of the tests the wires elongated more rapidly, a change in the rate, although not a pronounced one, taking place under loads of 130,000 to 160,000 pounds per square inch.

No. 7962.

Original diameter of coil, 12½″; wire straightened before testing.
Marks, No. 1–First.
Dimensions, ″.1007 by ″.1013.
Sectional area, .0102 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
10,000	0.	0.	Initial load.
20,000	.0038	....	
30,000	.0078	....	
40,000	.0120	....	
50,000	.0159	....	
60,000	.0202	....	
70,000	.0249	....	
80,000	.0287	....	
90,000	.0329	....	
100,000	.0384	.0035	
110,000	.0429	....	
120,000	.0478	....	
130,000	.0530	....	
140,000	.0585	....	
150,000	.0650	.0104	
160,000	.0709	....	
170,000	.0778	....	
180,000	.0862	....	
190,000	.0993	....	
200,000	.1200	.0415	
221,670	....	....	Tensile strength.
0	.19	....	=1.9 per cent.

Dimensions at fracture, ″.076 by ″.076; area, .0058 square inch.
Contraction of area, 43.1 per cent.
Fractured within the gauged length.
Appearance of fracture, fine silky.

No. 7963.

Original diameter of coil, 13″; wire straightened before testing.
Marks, No. 1-Middle.
Dimensions, ″.1004 by ″.1012.
Sectional area, .0102 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
10,000	0.	0.	Initial load.
20,000	.0040	....	
30,000	.0087	....	
40,000	.0121	....	
50,000	.0159	.0012	
60,000	.0200	....	
70,000	.0248	....	
80,000	.0294	....	
90,000	.0332	....	
100,000	.0379	.0035	
110,000	.0417	....	
120,000	.0475	....	
130,000	.0525	....	
140,000	.0584	....	
150,000	.0642	.0094	
160,000	.0688	....	
170,000	.0755	....	
180,000	.0820	....	
190,000	.0910	....	
200,000	.1051	.0285	
234,310	....	....	Tensile strength.
0	.08	....	=0.8 per cent.

Dimensions at fracture, ″.082 by ″.082; area, .0067 square inch.
Contraction of area, 34.3 per cent.
Fractured outside the gauged length.
Appearance of fracture, fine silky.

No. 7964.

Original diameter of coil, 15″; wire straightened before testing.
Marks, No. 2–First.
Dimensions, ″.1011 by ″.1011.
Sectional area, .0102 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
10,000	0.	0.	Initial load.
20,000	.0038		
30,000	.0076		
40,000	.0117		
50,000	.0160	.0011	
60,000	.0210		
70,000	.0244		
80,000	.0283		
90,000	.0327		
100,000	.0373	.0030	
110,000	.0420		
120,000	.0465		
130,000	.0518		
140,000	.0575		
150,000	.0638	.0092	
160,000	.0714		
170,000	.0772		
180,000	.0869		
190,000	.0957		
200,000	.1108	.0333	
224,510			Tensile strength.
0	.12		=1.2 per cent.

Dimensions at fracture, ″.075 by ″.075; area, .0056 square inch.
Contraction of area, 45.1 per cent.
Fractured within the gauged length.
Appearance of fracture, fine silky.

No. 7965.

Original diameter of coil, 17½″; wire straightened before testing.
Marks, No. 2–Middle.
Dimensions, ″.1014 by ″.1014.
Sectional area, .0103 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
10,000	0.	0.	Initial load.
20,000	.0038	....	
30,000	.0076	....	
40,000	.0110	....	
50,000	.0150	0.	
60,000	.0196	....	
70,000	.0236	....	
80,000	.0277	....	
90,000	.0321	....	
100,000	.0361	.0020	
110,000	.0410	....	
120,000	.0451	....	
130,000	.0500	....	
140 000	.0550	....	
150,000	.0603	.0065	
160,000	.0655	....	
170,000	.0721	....	
180,000	.0782	....	
190,000	.0855	....	
200,000	.0970	.0210	
232,040	....	....	Tensile strength.
0	.12	....	=1.2 per cent.

Dimensions at fracture, ″.076 by ″.076; area, .0058 square inch.
Contraction of area, 43.7 per cent.
Fractured within the gauged length.
Appearance of fracture, fine silky.

No. 7966.

Original diameter of coil, 17″; wire straightened before testing.
Marks, No. 3–First.
Dimensions, ″.1003 by ″.1003.
Sectional area, .0100 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
10,000	0.	0.	Initial load.
20,000	.0030		
30,000	.0074		
40,000	.0112		
50,000	.0150	0.	
60,000	.0195		
70,000	.0230		
80,000	.0275		
90,000	.0320		
100,000	.0360	.0023	
110,000	.0400		
120,000	.0451		
130,000	.0500		
140,000	.0550		
150,000	.0603	.0065	
160,000	.0660		
170,000	.0738		
180,000	.0800		
190,000	.0887		
200,000	.1012	.0239	
239,000			Tensile strength.
0	.15		=1.5 per cent.

Dimensions at fracture, ″.080 by ″.080; area, .0064 square inch.
Contraction of area, 36 per cent.
Fractured within the gauged length.
Appearance of fracture, fine silky.

No. 7967.

Original diameter of coil, 16½"; wire straightened before testing.
Marks, No. 3–Middle.
Dimensions, ".1000 by ".0996.
Sectional area, .010 square inch.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
10,000	0.	0.	Initial load.
20,000	.0040		
30,000	.0090		
40,000	.0130		
50,000	.0170	.0008	
60,000	.0220		
70,000	.0257		
80,000	.0305		
90,000	.0345		
100,000	.0392	.0031	
110,000	.0431		
120,000	.0485		
130,000	.0542		
140,000	.0590		
150,000	.0659	.0104	
160,000	.0721		
170,000	.0810		
180,000	.0913		
190,000	.1005		
200,000	.1192	.0394	
227,000			Tensile strength.
0	.09		=0.9 per cent.

Dimensions at fracture, ".076 by ".076; area, .0058 square inch.
Contraction of area, 42 per cent.
Fractured outside the gauged length.
Appearance of fracture, fine silky.

PROOF STRESSES.

PISTON RODS.

For—	Proof stress applied.
	Pounds.
6-inch Barbette carriages, model 1900	340,000
Do	320,000
12-inch disappearing carriages	150,000
75-millimeter mountain gun carriages	12,500
10-inch disappearing carriages	240,000

RETRACTION ROPES.

(¾" diameter, with sockets.)

12-inch disappearing carriages	15,000

STEEL FOR COMPARISON OF TESTING MACHINES.

STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT WORKS OF THE RARIG ENGINEERING COMPANY, COLUMBUS, OHIO.

No. 7846.

Marks, R.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0008	....	
20,000	.0013	....	
30,000	.0020	0.	
39,000	.0029	....	Elastic limit. Load fell.
36,000	.0092	....	
37,000	.0240	....	
38,000	.0439	....	
39,000	.0180	....	
40,000	.0515	....	
58,100	....	....	Tensile strength.
0	.71	....	=35.5 per cent.

Elongation of inch sections, ″.43*, ″.28.
Diameter at fracture, ″.29; area, .0661 square inch.
Contraction of area, 66.9 per cent.
Fractured 1″.25 from the neck.
Appearance of fracture, fine silky.

No. 7847.

Marks, R.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
20,000	.0014	....	
30,000	.0021	0.	
38,000	.0029	....	Elastic limit. Load fell.
35,000	.0058	....	
36,000	.0076	....	
37,000	.0109	....	
38,000	.0410	....	
39,000	.0480	....	
40,000	.0518	....	
58,200	....	....	Tensile strength.
0	.71	....	=35.5 per cent.

Elongation of inch sections, ″.36*, ″.35*.
Diameter at fracture, ″.30; area, .0707 square inch.
Contraction of area, 64.6 per cent.
Fractured at the middle of the stem.
Appearance of fracture, fine silky.

No. 7848.

Marks, R.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0006	....	
20,000	.0012	....	
30,000	.0020	0.	
38,000	.0026	....	Elastic limit. Load fell.
35,000	.0055	....	
36,000	.0080	....	
37,000	.0400	....	
38,000	.0425	....	
39,000	.0450	....	
40,000	.0524	....	
58,200	....	....	Tensile strength.
0	.72	....	=36 per cent.

Elongation of inch sections, ″.50*, ″.22.
Diameter at fracture, ″.30; area, .0707 square inch.
Contraction of area, 64.6 per cent.
Fractured ″.9 from the neck.
Appearance of fracture, fine silky.

STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT BALTIMORE, MD.

No. 7922.

Marks, 2–STL.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0007	....	
20,000	.0013	....	
30,000	.0020	0.	
40,000	.0028	....	
44,000	.0031	....	Elastic limit. Load fell.
39,000	.0060	....	
40,000	.0073	....	
41,000	.0100	....	
42,000	.0130	....	
43,000	.0139	....	
44,000	.0150	....	
45,000	.0169	....	
46,000	.0178	....	
48,000	.0205	....	
50,000	.0237	....	
52,000	.0270	....	
54,000	.0302	....	
56,000	.0339	....	
58,000	.0370	....	
60,000	.0417	....	
64,000	.0500	....	
68,000	.0608	....	
72,000	.0730	....	
76,000	.0881	....	
80,000	.1123	....	
84,000	.1450	....	
88,000	.21	....	
89,100	.35	....	Tensile strength.
0	.45	....	=22.5 per cent.

Load on bar at time of rupture, 17,000 pounds = 122,740 pounds per square inch on area at fracture.

Elongation of inch sections, ″.20*, ″.25*.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 30.7 per cent.

Fractured at the middle of the stem.

Appearance of fracture, granular, 60 per cent; silky, 40 per cent.

No. 7923.

Marks, 3-STL.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
20,000	.0014	....	
30,000	.0024	.0003	Elastic limit.
32,000	.0027	....	
34,000	.0040	....	
35,000	.0060	.0031	
36,000	.0069	....	
38,000	.0091	....	
40,000	.0119	....	
42,000	.0142	....	
44,000	.0172	....	
46,000	.0203	....	
48,000	.0233	....	
50,000	.0265	....	
52,000	.0300	....	
54,000	.0340	....	
56,000	.0382	....	
58,000	.0420	....	
60,000	.0475	....	
64,000	.0570	....	
68,000	.0698	....	
72,000	.0850	....	
76,000	.1040	....	
80,000	.1400	....	
84,000	.21	....	
85,800	.32	....	Tensile strength.
0	.43	....	=21.5 per cent.

Load on bar at time of rupture, 17,200 pounds = 118,460 pounds per square inch on area at fracture.

Elongation of inch sections, ″.19, ″.24*.

Diameter at fracture, ″.43; area, .1452 square inch.

Contraction of area, 27.4 per cent.

Fractured at the middle of the stem.

Appearance of fracture, granular, 60 per cent; silky, 40 per cent.

STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT WORKS OF VICKER'S SONS & MAXIM (LIMITED), LONDON, ENGLAND.

No. 7934.

Marks, WA.
Diameter, ″.798.
Sectional area, .50 square inch.
Gauged length, 8″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0024	....	
20,000	.0051	....	
30,000	.0077	0.	
35,000	.0092	....	
40,000	.0104	0.	
40,600	....	....	Elastic limit. Load fell.
30,000	.0196	....	
31,000	.0270	....	
32,000	.0855	....	
33,000	.0965	....	
34,000	.1070	....	
36,000	.36	....	
38,000	.41	....	
40,000	.51	....	
42,000	.60	....	
44,000	.72	....	
46,000	.98	....	
48,000	1.58	....	
48,240	....	....	Tensile strength.
0	2.79	....	=34.9 per cent.

Elongation of inch sections, ″.22, ″.27, ″.30, ″.53, ″.66*, ″.31, ″.26, ″.24.

Diameter at fracture, ″.41; area, .1320 square inch.
Contraction of area, 73.6 per cent.
Fractured at middle of stem.
Appearance of fracture, fine silky.

No. 7935.

Marks, .17C.
Diameter, ″.798.
Sectional area, .50 square inch.
Gauged length, 8″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0024	....	
20,000	.0051	....	
30,000	.0079	0.	
35,000	.0094	....	
40,000	.0106	....	
41,000	.0109	....	
42,000	.0112	....	
43,000	.0114	....	
44,000	.0117	....	
45,000	.0120	....	
46,000	.0123	....	
47,000	.0126	....	
48,000	.0129	....	
49,000	.0131	....	
50,000	.0133	0.	
51,000	.0136	....	Elastic limit. Load fell.
46,000	.0184	....	
47,000	.1885	....	
48,000	.20	....	
50,000	.23	....	
52,000	.26	....	
56,000	.35	....	
60,000	.46	....	
64,000	.62	....	
68,000	1.03	....	
69,080	1.58	....	Tensile strength.
0	2.07	....	=25.9 per cent.

Elongation of inch sections, ″.18, ″.21, ″.24, ″.50*, ″.36, ″.22, ″.19, ″.17.

Diameter at fracture, ″.55; area, .2376 square inch.

Contraction of area, 52.5 per cent.

Fractured at middle of stem.

Appearance of fracture, fine silky, cup-shaped.

No. 7936.

Marks, .55C.
Diameter, .798.
Sectional area, .50 square inch.
Gauged length, 8″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	0.	
10,000	.0022	....	
20,000	.0050	....	
30,000	.0078	0.	
35,000	.0092	....	
40,000	.0105	....	
45,000	.0119	....	
50,000	.0131	0.	
55,000	.0145	....	
58,600	....	....	Elastic limit. Load fell.
55,000	.0189	....	
56,000	.0242	....	
58,000	.0665	....	
60,000	.0728	....	
64,000	.10	....	
68,000	.13	....	
72,000	.15	....	
76,000	.18	....	
80,000	.20	....	
84,000	.23	....	
88,000	.28	....	
92,000	.32	....	
96,000	.38	....	
100,000	.46	....	
104,000	.60	....	
107,200	1.02	....	Tensile strength.
0	1.10	....	=13.8 per cent.

Elongation of inch sections, ″.11, ″.11, ″.13, ″.16, ″.22*, ″.15, ″.12, ″.10.

Diameter at fracture, ″.71; area, .3959 square inch.

Contraction of area, 20.8 per cent.

Fractured 4″ from the neck.

Appearance of fracture, fine granular; silky spot at center.

STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT WORKS OF ISAAC G. JOHNSON & CO., SPUYTEN DUYVIL, N. Y.

No. 7946.

Marks, 2.
Diameter, ″.497.
Sectional area, .194 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0006		
20,000	.0012		
30,000	.0019		
40,000	.0025		
45,000	.0029		Elastic limit. Load fell.
38,000	.0069		
39,000	.0080		
40,000	.0210		
45,000	.0760		
50,000	.1250		
59,330			Tensile strength.
0	.74		=37 per cent.

Elongation of inch sections, ″.40*, ″.34.
Diameter at fracture, ″.29; area, .0661 square inch.
Contraction of area, 65.9 per cent.
Fractured at the middle of the stem.
Appearance of fracture, fine silky.

No. 7947.

Marks, 4.
Diameter, ″.497.
Sectional area, .194 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0007		
20,000	.0013		
30,000	.0019		
40,000	.0027		
45,000	.0030		Elastic limit. Load fell.
38,000	.0075		
39,000	.0088		
40,000	.0155		
45,000	.0770		
50,000	.1310		
58,870			Tensile strength.
0	.76		=38 per cent.

Elongation of inch sections, ″.41*, ″.35.
Diameter at fracture, ″.28; area, .0616 square inch.
Contraction of area, 68.2 per cent.
Fractured at the middle of the stem.
Appearance of fracture, fine silky.

No. 7948.

Marks, 6.
Diameter, ″.497.
Sectional area, .194 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0007	....	
20,000	.0013	....	
30,000	.0019	....	
40,000	.0026	....	
43,000	.0030..	....	Elastic limit. Load fell.
38,000	.0055	....	
39,000	.0080	....	
40,000	.0160	....	
45,000	.0785	....	
50,000	.1250	....	
58,870	....	....	Tensile strength.
0	76	....	=38 per cent.

Elongation of inch sections, ″.32, ″.44*.
Diameter at fracture, ″.29; area, .0661 square inch.
Contraction of area, 65.9 per cent.
Fractured at the middle of the stem.
Appearance of fracture, fine silky.

No. 7949.

Marks, 8.
Diameter, ″.497.
Sectional area, .194 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0007	....	
20,000	.0013	....	
30,000	.0019	....	
40,000	.0027	....	
43.000	.0029	....	Elastic limit. Load fell.
38,000	.0062	....	
39,000	.0098	....	
40,000	.0250	....	
45,000	.0630	....	
50,000	.1310	....	
58,660	....	....	Tensile strength.
0	.75	....	=37.5 per cent.

Elongation of inch sections, ″.25, ″.50*.
Diameter at fracture, ″.28; area, .0616 square inch.
Contraction of area, 68.2 per cent.
Fractured 1″.15 from the neck.
Appearance of fracture, fine silky.

ADDITIONAL STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT WORKS OF ISAAC G. JOHNSON & CO., SPUYTEN DUYVIL, N. Y.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
			Total	Per square inch.	Total.	Per square inch.						
	Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per cent.*	*Inch.* *Sq. inch.*	*Per cent.*		″ ″
2	.500	.196	8,500	43,370	11,910	60,770	.73	36.5	.29 diameter = .066	66.3	Fine silky	.44*, .29
4	.500	.196	9,310	47,500	11,870	60,560	.72	36.0	.28 diameter = .062	68.4	do	.32, .40*
6	.500	.196	8,360	42,650	11,750	59,950	.72	36.0	.29 diameter = .066	66.3	do	.24, .48*
8	.500	.196	8,340	42,550	11,670	59,540	.73	36.5	.28 diameter = .062	68.4	do	.47*, .26

FOR COMPARISON OF TESTING MACHINES.

At the works of—	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	″ ″	
Jones & Laughlin 1	45,100	88,500	24.5	40.3	.26*, .23*	Fine silky.
Do 2	36,000	66,000	33.0	57.2	.26, .40*	Do.
Do 3	44,500	52,100	40.5	75.4	.56*, .25	Do.
C. H. Cowdrey Machine Co	53,000	67,000	34.0	64.6	.25, .43*	Do.
Do	52,500	67,000	34.5	64.6	.33*, .36*	Do.
Do	53,000	66,900	34.0	64.6	.41*, .27	Do.

HELICAL SPRINGS.

HELICAL SPRINGS FOR GUN CARRIAGES.

COMPRESSION TESTS OF HELICAL SPRINGS FURNISHED BY THE WM. D. GIBSON COMPANY.

COUNTERBALANCE SPRINGS FOR 10-INCH DISAPPEARING CARRIAGES, L. F. MODEL 1894.

SPECIFICATIONS.

Outside diameter.....inches..	4.5
Diameter of wire.....inch..	.625
Number of effective coils.....	13
Free height, approximate.....inches..	15.7
Solid height, approximate.....do...	8.75

To sustain a load of 1,475 pounds at a height of 11 inches. Spring to be compressed solid 100 times as rapidly as possible without taking a permanent set.

Prior to the above tests spring is to be compressed solid for 60 hours.

DESCRIPTION OF SPRINGS RECEIVED.

	Spring number.	
	1.	2.
Exterior diameter.....inches..	4.51	4.52
Diameter of wire.....inch..	.61	.62
Free height.....inches..	16.04	16.10
Distance between coils.....inch..	.60	.57
Weight.....pounds..	14.28	14.53
Springs closed down about 60 hours.		
Free height.....inches..	16.01	16.05
Springs closed down 100 times.		
Free height.....inches..	15.95	16.00

TESTS OF THE SPRINGS.

Height at 1,475 pounds load.....inches..	11.16	11.15
Load at 11 inches height.....pounds..	1,550	1,520
Height, solid.....inches..	8.82	8.81
Load, solid.....pounds..	2,390	2,290
Load at 11 inches height.....do...	1,500	1,475
Height at 1,475 pounds load.....inches..	11.05	11.00

COUNTERBALANCE SPRING FOR 10-INCH DISAPPEARING CARRIAGE, L. F. MODEL 1901.

SPECIFICATIONS.

Outside diameter	inches..	5.5
Diameter of wire	inch..	.875
Number of effective coils		10
Free height, approximate	inches..	15
Solid height, approximate	do...	9.625

To sustain a load of 2,300 pounds at a height of 12.125 inches. Spring to be compressed solid 100 times without taking a permanent set.

Prior to the above tests spring is to be compressed solid for 60 hours.

DESCRIPTION OF SPRING RECEIVED.

Exterior diameter	inches..	5.50
Diameter of wire	inch..	.88
Distance between coils	do...	.57
Free height	inches..	15.01
Weight	pounds..	26.28
Spring closed down about 60 hours.		
Free height	inches..	14.91
Spring closed down 100 times.		
Free height	inches..	14.89

TEST OF THE SPRING.

Height at 2,300 pounds load	inches..	12.28
Load at 12.125 inches height	pounds..	2,430
Height, solid	inches..	9.77
Load, solid	pounds..	4,680
Load at 12.125 inches height	do...	2,340
Height at 2,300 pounds load	inches..	12.17

COUNTERBALANCE SPRING FOR 12-INCH DISAPPEARING CARRIAGE, L. F. MODEL 1901.

SPECIFICATIONS.

Number of coils		12
Diameter of wire	inch..	.875
Outside diameter	inches..	5.5
Free height, about	do...	17.8
Solid height, approximate	do...	10.5

At a height of 14 inches (+0.5 inch), to sustain a load of 2,900 pounds. Spring to be compressed 100 times to solid height as rapidly as possible, load being released after each compression, after which it shall support at least 2,900 pounds at a height of 14 inches, +0.5 inch. Effective movement from assembled to solid height, not less than 3.5 inches.

Prior to the above tests the spring is to be compressed solid for 60 hours.

DESCRIPTION OF SPRING RECEIVED.

Free height	inches..	18.35
Exterior diameter	do...	5.50
Diameter of wire	inch..	.87
Distance between coils	do...	.75
Weight	pounds..	28.84
Closed solid about 60 hours.		
Free height	inches..	18.21
Loaded 100 times.		
Free height	inches..	17.95

TEST OF THE SPRING.

Height at 2,900 pounds load	inches..	14.28
Load at 14.5 inches height	pounds..	2,740
Height, solid	inches..	10.72
Load, solid	pounds..	5,600
Load at 14.5 inches height	do...	2,520
Height at 2,900 pounds load	inches..	13.98

COMPRESSION TESTS OF HELICAL SPRINGS FURNISHED BY THE RAILWAY STEEL SPRING COMPANY.

(These springs are duplicates of the ones furnished by The Wm. D. Gibson Company, and specifications are the same.)

Counterbalance Springs for 10-Inch Disappearing Carriages, L. F. Model 1894.

DESCRIPTION OF SPRINGS RECEIVED.

		Spring number.	
		1.	2.
Free height	inches..	17.15	16.80
Exterior diameter	do...	4.45	4.47
Interior diameter	do...	3.25	3.24
Diameter of wire	inch..	.60	.62
Distance between coils	do...	.70	.68
Weight	pounds...	13.72	14.16
Closed down about 60 hours.			
Free height	inches..	16.80	16.42
Loaded 100 times.			
Free height	inches..	16.55	16.45

TESTS OF THE SPRINGS.

Height at 1,475 pounds load	inches..	11.00	11.58
Load at 11 inches height	pounds..	1,475	1,650
Height, solid	inches..	8.65	8.85
Load, solid	pounds..	2,290	2,370
Load at 11 inches height	do...	1,433	1,586
Height at 1,475 pounds load	inches..	10.95	11.37

Counterbalance Spring for 10-Inch Disappearing Carriage, L. F. Model 1901.

DESCRIPTION OF SPRING RECEIVED.

Free height	inches..	15.28
Exterior diameter	do...	5.46
Interior diameter	do...	3.75
Diameter of wire	inch..	.86
Distance between coils	do...	.60
Weight	pounds..	26.62
Closed down about 60 hours.		
Free height	inches..	15.14
Loaded 100 times.		
Free height	inches..	15.10

TEST OF THE SPRING.

Height at 2,300 pounds load	inches..	12.45
Load at 12.125 inches height	pounds..	2,585
Height, solid	inches..	9.72
Load, solid	pounds..	4,890
Load at 12.125 inches height	do...	2,496
Height at 2,300 pounds load	inches..	12.35

Counterbalance Spring for 12-Inch Disappearing Carriage, L. F. Model 1901.

DESCRIPTION OF SPRING RECEIVED.

Free height	inches..	18.69
Exterior diameter	do...	5.45
Interior diameter	do...	3.73
Diameter of wire	inch..	.86
Distance between coils	do...	.81
Weight	pounds..	28.90
Closed down about 60 hours.		
Free height	inches..	17.80
Loaded 100 times.		
Free height	inches..	17.50

TEST OF THE SPRING.

Height at 2,900 pounds load	inches	13.78
Load at 14.5 inches height	pounds	2,825
Height, solid	inches	10.48
Load, solid	pounds	5,680
Load at 14.5 inches height	do	2,080
Height at 2,900 pounds load	inches	13.48

COMPRESSION TESTS OF HELICAL SPRINGS FURNISHED BY THE WM. D. GIBSON COMPANY.

BUFFER SPRINGS FOR 12-INCH DISAPPEARING CARRIAGES, MODEL 1901.

Specifications require—

Height under 3,400 pounds load	inches	10.375
Height, solid	do	8.375
Load at solid height not less than	pounds	6,750
Maximum outside diameter	inches	4

DIMENSIONS OF SPRINGS RECEIVED.

	Spring number.							
	1.	2.	3.	4.	5.	6.	7.	8.
Free height .... inches	12.54	12.32	12.15	12.44	12.68	12.50	12.58	12.30
Exterior diameter .... do	4.03	......	......	......	......	......	......	......
Interior diameter .... do	2.43	......	......	......	......	......	......	......
Diameter of wire .... inch	.80	......	......	......	......	......	......	......
Distance between coils .... do	.47	......	......	......	......	......	......	......
Weight .... pounds	15	......	......	......	......	......	......	......

TESTS OF THE SPRINGS.

	Spring number.							
	1.	2.	3.	4.	5.	6.	7.	8.
Height at 3,400 pounds load, inches	10.60	10.58	10.40	10.60	10.84	10.70	10.76	10.55
Load at 10.375 inches height, pounds	3,806	3,765	3,430	3,785	4,190	3,974	4,110	3,690
Height, solid .... inches	8.41	8.48	8.48	8.54	8.64	8.42	8.56	8.48
Load, solid .... pounds	6,860	6,850	6,910	6,760	6,970	7,280	7,070	7,070
Load at 10.375 inches height. pounds	2,810	2,695	2,704	2,808	3,296	3,140	3,265	2,605
Height at 3,400 pounds load, inches	10.05	10.02	10.01	10.06	10.30	10.24	10.30	9.95
Free height .... inches	12.14	12.18	11.86	12.14	12.44	12.40	12.41	12.05
Height at 3,400 pounds load, inches	10.375	10.30	10.21	10.375	10.60	10.54	10.59	10.25
Load at 10.375 inches height, pounds	3,400	3,300	3,110	3,400	3,806	3,630	3,785	3,190

HELICAL, PAWL SPRING, 8-INCH DISAPPEARING CARRIAGE, MODEL 1894.

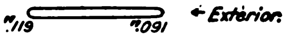
Spring made of brass wire.

Free height	inches	5.03
Exterior diameter	do	1.20
Diameter of wire	inch	.25
Pitch	do	.50
Load at 3.18 inches height	pounds	324
Free height	inches	4.60
Height, closed down	do	2.55
Load, closed down	pounds	420
Final free height	inches	4.06
Total set from original free height	inch	.97

Buffer Springs for 75-Millimeter Gun Carriages.

Twelve springs from The Wm. D. Gibson Company, Chicago, Ill.

DESCRIPTION OF ONE SPRING.

Free height	inches	31.10
Number of coils		52¼
Pitch	inch	.60
Exterior diameter	inches	2.14
Interior diameter	do	1.12
Dimensions of ribbon		

	Numbers of springs.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Original free heights ... inches	31.10	30.80	31.19	31.20	30.65	30.98	31.15	30.92	31.20	30.80	30.89	30.80
Heights after being closed down 64 hours ... do	30.74	30.24	30.73	30.67	30.42	30.70	30.60	30.22	30.48	30.12	30.50	30.45
Heights after 100 loadings, 21".1 to 7".0 ... do	30.56	....	....	....	29.98	....	....	....	30.50	....	....	....
Heights at 105 pounds ... do	22.40	22.15	22.87	22.65	22.35	22.20	23.20	22.37	22.80	22.20	22.18	22.20
Loads at 21".1 ... pounds	122.00	120.00	132.00	129.00	125.00	118.00	134.00	123.00	133.00	120.00	122.00	123.00
Heights closed down ... inches	6.44	6.30	6.25	6.00	6.22	6.44	6.45	6.50	6.45	6.30	6.38	6.37
Loads closed down ... pounds	326.00	322.00	334.00	344.00	326.00	324.00	336.00	314.00	321.00	331.00	304.00	330.00
Heights at 105 pounds ... inches	21.65	21.85	21.75	21.40	21.52	20.90	21.72	21.20	21.42	20.74	21.15	21.20
Loads at 21".1 ... pounds	112.00	118.00	111.00	111.00	110.00	103.00	112.00	108.00	113.00	101.00	107.00	104.00
Final free heights ... inches	30.54	30.35	30.94	31.00	30.29	30.45	31.08	30.23	30.59	30.21	30.32	30.19

COMPRESSION TESTS OF HELICAL SPRINGS FURNISHED BY THE WM. D. GIBSON COMPANY.

BUFFER SPRINGS FOR 75-MILLIMETER MOUNTAIN GUN CARRIAGES.

No. of spring.	Closed.		Load at 7".	Load at 21".1.	Remarks.
	Height.	Load.			
	Inches.	*Pounds.*	*Pounds.*	*Pounds.*	
1	6.42	390	....	118	
2	6.25	336	....	112	
3	6.24	325	....	100	
4	6.60	404	314	108	
5	6.60	372	308	118	
6	6.60	337	314	108	
7	6.60	394	314	112	
8	6.51	380	306	109	
9	6.51	367	290	100	
10	6.42	360	....	110	
11	6.60	356	321	119	
12	6.60	358	318	115	
13	6.60	356	325	120	
14	6.60	383	310	111	
15	6.27	360	....	94	
16	6.56	368	299	114	
17	6.50	327	282	105	
18	6.35	350	....	96	
19	6.60	342	302	103	
20	6.60	359	282	99	
21	6.28	340	270	97	
22	6.60	378	330	115	
23	6.50	332	290	102	
24	6.60	362	308	108	
25	6.37	339	271	105	
26	6.60	375	322	113	
27	6.60	368	315	111	
28	6.40	358	292	112	
29	6.60	356	323	114	
30	6.60	368	313	113	
31	6.58	353	317	118	
32	6.56	360	298	108	
33	6.57	343	313	109	
34	6.59	347	317	122	
35	6.57	335	294	110	
36	6.59	340	321	112	
37	6.60	421	322	118	
38	6.60	374	312	114	
39	6.57	358	310	111	
40	6.57	328	298	107	
41	6.57	346	312	114	
42	6.58	360	330	116	
43	6.55	340	303	112	
44	6.48	332	298	109	
45	6.54	364	312	109	
46	6.40	336	284	102	
47	6.55	328	292	103	
48	6.45	350	301	112	
49	6.57	345	304	109	
50	6.57	339	300	107	
51	6.60	354	306	110	
52	6.56	372	314	111	
53	6.48	335	303	110	
54	6.59	350	310	110	
55	6.49	353	312	118	
56	6.50	344	312	110	
57	6.60	349	325	122	
58	6.40	365	304	114	
59	6.56	368	308	110	
60	6.38	355	285	108	
61	6.57	316	308	114	
62	6.60	400	288	100	
63	6.60	435	321	109	
64	6.60	341	298	113	
65	6.50	349	306	110	
66	6.51	342	316	112	
67	6.60	370	325	119	
68	6.56	350	313	111	
69	6.59	370	325	114	
70	6.59	354	310	102	
71	6.60	341	309	108	
72	6.61	349	292	110	
73	6.60	359	311	116	

BUFFER SPRINGS FOR 75-MILLIMETER MOUNTAIN GUN CARRIAGES—Continued.

No. of spring.	Closed.		Load at 7".	Load at 21".1.	Remarks.
	Height.	Load.			
	Inches.	*Pounds.*	*Pounds.*	*Pounds.*	
74	6.50	365	314	118	
75	6.41	352	291	106	
76	6.54	358	302	108	
77	6.43	360	293	104	
78	6.44	342	307	114	
79	6.60	363	316	107	
80	6.50	356	307	112	
81	6.51	366	314	112	
82	6.30	360	291	104	
83	6.50	362	302	119	
84	6.60	374	312	114	
85	6.60	343	312	114	
86	6.60	373	320	118	
87	6.60	404	316	118	
88	6.60	338	294	108	
89	6.31	340	282	99	
90	6.59	350	290	99	
91	6.60	357	311	108	
92	6.58	360	318	110	
93	6.60	380	310	111	
94	6.52	332	300	110	
95	6.60	366	320	112	
96	6.39	342	270	98	
97	6.50	360	307	105	
98	6.60	392	310	110	
99	6.54	372	302	110	
100	6.49	342	280	105	
101	6.60	386	302	102	
102	6.60	362	330	120	
103	6.37	338	262	102	
104	6.35	365	286	108	
105	6.60	410	320	118	
106	6.60	386	320	114	
107	6.47	322	285	101	
108	6.21	304	254	95	
109	6.45	331	284	100	
110	6.60	380	308	112	
111	6.43	348	300	110	
112	6.60	390	324	118	
113	6.60	400	312	110	
114	6.20	338	278	106	
115	6.37	342	270	100	
116	6.45	331	273	100	
117	6.60	410	312	115	
118	6.60	440	304	110	
119	6.58	370	310	109	
120	6.49	336	283	105	
121	6.47	360	283	105	
122	6.60	380	300	108	
123	6.60	384	308	110	
124	6.55	350	280	102	
125	6.50	368	300	110	
126	6:60	378	290	106	
127	6.45	358	296	110	
128	6.60	380	300	105	
129	6.60	376	292	105	
130	6.32	388	290	109	
131	6.42	359	294	109	
132	6.51	384	318	111	
133	6.48	360	280	105	
134	6.60	359	298	112	
135	6.97	368	310	107	
136	6.55	360	300	110	
137	6.60	370	320	108	
138	6.58	370	302	107	
139	6.60	384	314	112	
140	6.60	358	290	100	
141	6.50	340	289	102	
142	6.38	370	283	100	
143	6.30	350	278	100	
144	6.60	364	293	109	
145	6.60	424	300	108	
146	6.44	365	316	117	
147	6.60	332	300	105	
148	6.21	370	290	106	

BUFFER SPRINGS FOR 75-MILLIMETER MOUNTAIN GUN CARRIAGES—Continued.

No. of spring.	Closed.		Load at 7″.	Load at 21″.1.	Remarks.
	Height.	Load.			
	Inches.	*Pounds.*	*Pounds.*	*Pounds.*	
149	6.56	364	288	100	
150	6.50	380	296	104	
151	6.60	345	318	110	
152	6.60	385	288	102	
153	6.60	334	283	100	
154	6.52	360	271	105	
155	6.50	290	258	89	
156	6.53	340	295	106	
157	6.60	384	290	102	
158	6.60	339	303	105	
159	6.60	328	298	101	
160	6.60	370	319	110	
161	6.59	340	300	110	
162	6.60	344	310	108	
163	6.60	350	302	102	
164	6.59	312	285	98	
165	6.60	380	303	110	
166	6.43	338	290	105	
167	6.27	322	280	108	
168	6.60	355	305	108	
169	6.49	332	300	110	
170	6.60	339	299	105	
171	6.12	320	270	100	
172	6.60	352	307	104	
173	6.58	340	292	102	
174	6.58	304	287	104	
175	6.59	350	301	108	
176	6.52	361	300	105	
177	6.60	390	288	107	
178	6.41	322	280	100	
179	6.60	335	309	112	
180	6.68	374	302	101	
181	6.53	350	290	100	
182	6.45	360	291	100	
183	6.55	340	291	105	
184	6.20	332	280	103	
185	6.55	354	303	109	
186	6.50	356	291	103	
187	6.60	370	314	110	
188	6.60	345	300	102	
189	6.57	333	292	110	
190	6.55	330	300	112	
191	6.58	354	314	114	
192	6.52	351	309	115	
193	6.58	344	320	113	
194	6.60	352	298	102	
195	6.60	350	310	106	
196	6.60	362	306	110	
197	6.40	350	292	105	
198	6.50	331	302	108	
199	6.50	354	304	117	
200	6.60	355	306	110	
201	6.44	350	286	99	
202	6.45	332	282	105	
203	6.55	328	303	110	
204	6.57	342	305	110	
205	6.50	363	288	99	
206	6.60	430	314	113	
207	6.40	345	300	108	
208	6.60	360	312	114	
209	6.60	350	306	106	
210	6.60	343	310	106	
211	6.50	369	294	108	
212	6.60	321	298	101	
213	6.50	340	300	114	
214	6.60	390	304	105	
215	6.51	360	294	106	
216	6.30	340	286	101	
217	6.60	302	285	100	
218	6.60	338	310	105	
219	6.60	338	284	113	
220	6.55	375	310	110	
221	6.60	450	320	110	
222	6.56	360	314	118	
223	6.30	356	270	101	

BUFFER SPRINGS FOR 75-MILLIMETER MOUNTAIN GUN CARRIAGES—Continued.

No. of spring	Closed.		Load at 7".	Load at 21".1.	Remarks.	
	Height.	Load.			Length before 100 loadings.	Length after 100 loadings.
	Inches.	*Pounds.*	*Pounds.*	*Pounds.*		
224	6.60	352	302	106		
225	6.60	423	318	116		
226	6.59	315	293	108		
227	6.60	374	318	116		
228	6.54	368	294	108		
229	6.59	358	310	110		
230	6.60	355	306	111		
231	6.55	379	310	123		
232	6.38	355	288	106		
233	6.60	353	313	112		
234	6.60	370	312	107		
235	6.25	350	278	100		
236	6.42	340	280	106		
237	6.60	412	308	108		
238	6.60	358	319	110		
239	6.60	365	293	102		
240	6.60	430	328	120		
241	6.52	330	290	108		
242	6.59	335	290	103		
243	6.60	380	300	103		
244	6.48	360	309	112		
245	6.60	385	318	107		
246	6.56	360	295	107		
247	6.58	362	290	107		
248	6.51	360	300	110	*Inches.*	*Inches.*
249	6.50	332	272	100	31.00	30.00
250	6.10	354	287	108	....	....
251	6.52	355	308	106	....	....
252	6.50	325	290	108	....	....
253	6.60	341	315	104	31.00	30.00
254	6.07	340	292	103	....	....
255	6.47	314	300	101	....	....
256	6.60	343	293	94	....	....
257	6.35	303	278	100	30.50	29.125
258	6.51	296	281	106	....	....
259	6.34	322	292	107	....	....
260	6.60	404	321	110	....	....
261	6.54	323	292	99	30.625	29.625
262	6.30	310	280	95	....	....
263	6.50	317	290	102	....	....
264	6.60	450	308	102	....	....
265	6.60	370	304	108	30.375	29.75
266	6.60	380	288	94	....	....
267	6.60	360	304	100	....	....

COUNTER RECOIL SPRINGS.

CHEMICAL ANALYSES.

Description	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
75-mm. mountain gun carriage, "English"..	1.080	.940	.191	.018	.021
75-mm. mountain gun carriage, "Wm. D. Gibson"	.552	.690	.221	.065	.050
12-inch mortar carriage, outside spring......	1.050	....	....	....	....
7-inch mortar carriage	.900	.420	.170	.025	.016
12-inch mortar carriage, outside spring......	1.030	420	.210	.030	.010
12-inch mortar carriage, inside spring.......	1.050	.350	.095	.035	.020
3-inch experimental long recoil field carriage	.580	.730	.094	.060	.060

COPPER CYLINDERS FOR PRESSURE GAUGES.

Mean compression of 10 cylinders from Frankford Arsenal. Metal purchased May 20, 1901.

Table for use with crusher gauge one-tenth square inch area.

Mean dimensions of cylinders: Length, ″.4997; diameter, ″.2515.

Load per square inch on crusher gauge one-tenth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
3,000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6,000	.0035	.0043	.0050	.0045	.0047	.0048	.0036	.0043	.0050	.0045	.0044	.0042
9,000	.0158	.0151	.0170	.0148	.0155	.0154	.0147	.0160	.0160	.0170	.0157	.0152
10,000	.0218	.0196	.0206	.0189	.0196	.0203	.0205	.0205	.0203	.0206	.0203	.0197
11,900	.0248	.0230	.0248	.0228	.0237	.0241	.0235	.0248	.0248	.0250	.0241	.0235
12,000	.0294	.0274	.0290	.0265	.0260	.0278	.0281	.0298	.0296	.0302	.0284	.0277
13,000	.0339	.0315	.0331	.0312	.0325	.0340	.0328	.0339	.0342	.0345	.0332	.0324
14,000	.0390	.0361	.0378	.0360	.0367	.0374	.0383	.0376	.0384	.0391	.0376	.0367
15,000	.0441	.0392	.0420	.0404	.0408	.0418	.0414	.0421	.0442	.0439	.0420	.0410
16,000	.0490	.0449	.0470	.0458	.0465	.0464	.0464	.0460	.0490	.0497	.0471	.0460
17,000	.0546	.0498	.0520	.0510	.0518	.0524	.0520	.0520	.0542	.0545	.0524	.0513
18,000	.0595	.0545	.0576	.0568	.0560	.0570	.0566	.0569	.0594	.0597	.0574	.0563
19,000	.0655	.0595	.0635	.0595	.0600	.0615	.0620	.0616	.0641	.0655	.0623	.0612
20,000	.0700	.0646	.0677	.0680	.0665	.0650	.0664	.0670	.0698	.0710	.0676	.0665
21,000	.0750	.0700	.0736	.0705	.0722	.0713	.0729	.0725	.0745	.0757	.0728	.0717
22,000	.0815	.0745	.0789	.0737	.0768	.0787	.0779	.0774	.0800	.0806	.0780	.0769
23,000	.0865	.0807	.0828	.0830	.0840	.0822	.0835	.0834	.0851	.0860	.0837	.0826
24,000	.0926	.0858	.0885	.0876	.0887	.0888	.0895	.0885	.0897	.0911	.0891	.0879
25,000	.0983	.0915	.0960	.0940	.0936	.0960	.0955	.0944	.0950	.0967	.0951	.0939
26,000	.1038	.0970	.1010	.0993	.1019	.1015	.1007	.1000	.1012	.1016	.1008	.0996
27,000	.1100	.1030	.1073	.1040	.1062	.1071	.1067	.1074	.1077	.1075	.1067	.1055
28,000	.1158	.1089	.1132	.1106	.1118	.1140	.1135	.1128	.1132	.1130	.1127	.1115
29,000	.1220	.1147	.1200	.1170	.1170	.1197	.1187	.1180	.1186	.1210	.1187	.1175
30,000	.1288	.1198	.1265	.1231	.1204	.1258	.1239	.1244	.1253	.1245	.1243	.1231
31,000	.1335	.1257	.1323	.1279	.1280	.1315	.1308	.1297	.1305	.1308	.1301	.1289
32,000	.1398	.1310	.1370	.1335	.1320	.1380	.1363	.1350	.1362	.1355	.1354	.1342
33,000	.1474	.1370	.1429	.1400	.1397	.1445	.1415	.1405	.1419	.1400	.1415	.1403
34,000	.1502	.1430	.1485	.1452	.1446	.1495	.1480	.1461	.1488	.1480	.1472	.1460
35,000	.1577	.1481	.1550	.1520	.1528	.1540	.1528	.1515	.1551	.1549	.1533	.1519
36,000	.1606	.1550	.1600	.1569	.1580	.1605	.1593	.1578	.1600	.1600	.1588	.1574
37,000	.1695	.1595	.1657	.1625	.1641	.1660	.1633	.1634	.1652	.1655	.1645	.1631
38,000	.1738	.1648	.1729	.1675	.1695	.1730	.1695	.1680	.1719	.1705	.1701	.1687
39,000	.1789	.1710	.1760	.1730	.1754	.1770	.1752	.1742	.1764	.1767	.1754	.1740
40,000	.1846	.1763	.1812	.1775	.1818	.1815	.1796	.1800	.1818	.1815	.1806	.1792
41,000	.1900	.1807	.1870	.1850	.1850	.1886	.1850	.1845	.1880	.1865	.1860	.1846
42,000	.1955	.1870	.1921	.1880	.1901	.1925	.1898	.1895	.1930	.1915	.1909	.1895
43,000	.2005	.1905	.1960	.1940	.1960	.1960	.1955	.1945	.1982	.1976	.1963	.1949
44,000	.2058	.1960	.2038	.1979	.2020	.2043	.2005	.2004	.2030	.2027	.2016	.2002
45,000	.2103	.2020	.2088	.2039	.2065	.2083	.2052	.2053	.2076	.2072	.2065	.2051
46,000	.2190	.2062	.2130	.2100	.2106	.2119	.2095	.2100	.2123	.2121	.2115	.2101
47,000	.2210	.2110	.2171	.2138	.2155	.2175	.2131	.2150	.2167	.2167	.2157	.2143
48,000	.2245	.2155	.2230	.2201	.2198	.2220	.2189	.2196	.2213	.2210	.2206	.2192
49,000	.2290	.2198	.2264	.2226	.2250	.2255	.2230	.2235	.2255	.2249	.2245	.2231
50,000	.2336	.2235	.2310	.2266	.2280	.2304	.2270	.2278	.2291	.2292	.2286	.2272
51,000	.2375	.2285	.2341	.2310	.2317	.2348	.2311	.2317	2343	.2335	.2328	.2314
52,000	.2414	.2326	.2380	.2350	.2358	.2388	.2355	.2360	.2371	.2381	.2368	.2354
53,000	.2469	.2365	.2425	.2395	.2400	.2426	.2390	.2397	.2415	.2419	.2410	.2396
54,000	.2493	.2416	.2460	.2434	.2440	.2462	.2430	.2435	.2452	.2451	.2447	.2433
55,000	.2525	.2436	.2497	.2465	.2475	.2504	.2463	.2466	.2484	.2481	.2480	.2466
56,000	.2553	.2470	.2528	.2500	.2511	.2532	.2500	.2506	.2524	.2520	.2514	.2501
57,000	.2595	.2500	.2560	.2537	.2544	.2569	.2538	.2536	.2560	.2555	.2549	.2536
58,000	.2628	.2538	.2597	.2571	.2575	.2596	.2569	.2568	.2596	.2590	.2583	.2570
59,000	.2660	.2568	.2624	.2598	.2608	.2625	.2598	.2604	.2618	.2626	.2613	.2600
60,000	.2688	.2595	.2652	.2625	.2629	.2660	.2627	.2630	.2657	.2650	.2641	.2628

Load per square inch on crusher gauge one-tenth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
62,000	.2645	.2659	.2710	.2690	.2690	.2710	.2688	.2687	.2709	.2711	.2690	.2677
64,000	.2800	.2706	.2765	.2730	.2743	.2770	.2740	.2750	.2756	.2762	.2754	.2741
66,000	.2850	.2750	.2814	.2790	.2796	.2815	.2793	.2794	.2812	.2805	.2802	.2789
68,000	.2905	.2815	.2865	.2840	.2848	.2876	.2840	.2848	.2858	.2852	.2855	.2843
70,000	.2945	.2854	.2906	.2884	.2897	.2919	.2893	.2887	.2905	.2902	.2899	.2887
72,000	.2990	.2906	.2955	.2927	.2940	.2969	.2929	.2935	.2952	.2954	.2946	.2934
74,000	.3030	.2940	.3000	.2980	.2977	.3002	.2970	.2976	.3000	.2990	.2987	.2975
76,000	.3075	.2975	.3035	.3020	.3025	.3041	.3019	.3017	.3030	.3039	.3028	.3016
78,000	.3115	.3015	.3073	.3058	.3060	.3084	.3052	.3054	.3075	.3071	.3066	.3054
80,000	.3150	.3052	.3110	.3095	.3090	.3118	.3091	.3093	.3108	.3110	.3102	.3090
82,000	.3183	.3090	.3140	.3130	.3130	.3155	.3129	.3125	.3142	.3146	.3137	.3125
84,000	.3219	.3124	.3175	.3165	.3171	.3192	.3161	.3159	.3173	.3179	.3172	.3162
86,000	.3250	.3155	.3210	.3203	.3199	.3224	.3198	.3194	.3209	.3216	.3206	.3196
88,000	.3281	.3187	.3240	.3234	.3230	.3252	.3228	.3225	.3243	.3240	.3236	.3226
90,000	.3317	.3216	.3268	.3260	.3258	.3283	.3255	.3250	.3268	.3270	.3265	.3255
92,000	.3340	.3248	.3298	.3281	.3285	.3305	.3290	.3285	.3297	.3304	.3293	.3284
94,000	.3372	.3277	.3322	.3316	.3316	.3335	.3310	.3310	.3330	.3329	.3322	.3313
96,000	.3395	.3305	.3347	.3342	.3340	.3357	.3336	.3336	.3352	.3360	.3347	.3338
98,000	.3418	.3325	.3374	.3371	.3366	.3386	.3362	.3362	.3384	.3379	.3373	.3364
100,000	.3447	.3349	.3400	.3396	.3392	.3414	.3390	.3383	.3402	.3410	.3398	.3389

Mean compression of 10 cylinders from Frankford Arsenal. Metal purchased May 20, 1901.

Table for use with crusher gauge one-thirtieth square inch area.

Mean dimensions of cylinders: Length, ″.4997; diameter, ″.2044.

Load per square inch on crusher gauge one-thirtieth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
3,000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6,000	.0005	.0005	.0005	.0005	.0005	.0006	.0007	.0010	.0006	.0007	.0006	.0004
9,000	.0038	.0026	.0028	.0014	.0032	.0027	.0024	.0028	.0034	.0025	.0028	.0023
10,000	.0050	.0044	.0049	.0027	.0049	.0045	.0035	.0042	.0048	.0040	.0043	.0037
11,000	.0069	.0054	.0065	.0042	.0067	.0057	.0051	.0063	.0065	.0055	.0059	.0053
12,000	.0086	.0075	.0084	.0058	.0085	.0075	.0069	.0077	.0084	.0075	.0077	.0070
13,000	.0106	.0091	.0104	.0074	.0104	.0096	.0085	.0098	.0102	.0094	.0095	.0087
14,000	.0129	.0110	.0123	.0089	.0122	.0114	.0104	.0115	.0122	.0114	.0114	.0105
15,000	.0140	.0130	.0142	.0110	.0145	.0135	.0123	.0134	.0143	.0134	.0134	.0124
16,000	.0165	.0150	.0165	.0128	.0164	.0157	.0145	.0155	.0160	.0156	.0155	.0144
17,000	.0182	.0170	.0184	.0150	.0186	.0176	.0162	.0174	.0184	.0173	.0174	.0163
18,000	.0207	.0193	.0209	.0169	.0205	.0202	.0185	.0198	.0207	.0194	.0197	.0186
19,000	.0226	.0215	.0228	.0184	.0224	.0218	.0204	.0216	.0226	.0210	.0215	.0204
20,000	.0249	.0235	.0249	.0206	.0253	.0246	.0225	.0236	.0249	.0238	.0239	.0228
21,000	.0269	.0257	.0272	.0235	.0275	.0263	.0248	.0249	.0274	.0260	.0260	.0249
22,000	.0290	.0279	.0296	.0253	.0300	.0284	.0270	.0267	.0294	.0278	.0281	.0270
23,000	.0320	.0300	.0317	.0275	.0320	.0308	.0291	.0292	.0320	.0308	.0305	.0294
24,000	.0342	.0324	.0340	.0296	.0344	.0330	.0318	.0317	.0342	.0335	.0329	.0317
25,000	.0363	.0345	.0368	.0319	.0366	.0353	.0338	.0340	.0364	.0359	.0352	.0340
26,000	.0388	.0370	.0391	.0340	.0393	.0376	.0362	.0360	.0389	.0383	.0375	.0363
27,000	.0414	.0396	.0419	.0365	.0419	.0405	.0387	.0381	.0415	.0405	.0401	.0389
28,000	.0436	.0420	.0444	.0390	.0440	.0425	.0415	.0400	.0440	.0428	.0424	.0412
29,000	.0462	.0435	.0470	.0410	.0470	.0457	.0438	.0425	.0467	.0460	.0449	.0437
30,000	.0489	.0465	.0493	.0440	.0495	.0478	.0462	.0454	.0489	.0481	.0475	.0463
31,000	.0515	.0495	.0522	.0460	.0520	.0500	.0488	.0479	.0513	.0508	.0500	.0488
32,000	.0540	.0525	.0550	.0485	.0549	.0528	.0510	.0505	.0540	.0535	.0527	.0515
33,000	.0564	.0550	.0573	.0513	.0576	.0554	.0532	.0530	.0560	.0558	.0551	.0539
34,000	.0588	.0568	.0600	.0543	.0602	.0579	.0558	.0550	.0580	.0585	.0575	.0563
35,000	.0620	.0596	.0615	.0565	.0630	.0604	.0584	.0580	.0617	.0621	.0603	.0589
36,000	.0645	.0626	.0646	.0590	.0662	.0630	.0615	.0609	.0640	.0640	.0630	.0616
37,000	.0665	.0652	.0676	.0616	.0687	.0660	.0639	.0635	.0672	.0680	.0658	.0644

Load per square inch on crusher gauge one-tenth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
38,000	.0700	.0680	.0705	.0636	.0714	.0690	.0668	.0662	.0695	.0704	.0685	.0671
39,000	.0730	.0710	.0734	.0666	.0740	.0715	.0690	.0691	.0724	.0726	.0713	.0699
40,000	.0755	.0740	.0755	.0694	.0765	.0740	.0720	.0720	.0744	.0748	.0738	.0724
41,000	.0768	.0764	.0785	.0720	.0794	.0765	.0749	.0745	.0771	.0781	.0764	.0750
42,000	.0790	.0792	.0814	.0749	.0820	.0794	.0774	.0775	.0820	.0814	.0794	.0780
43,000	.0818	.0815	.0840	.0780	.0855	.0829	.0808	.0802	.0827	.0844	.0822	.0808
44,000	.0835	.0850	.0869	.0810	.0885	.0850	.0834	.0827	.0850	.0879	.0849	.0835
45,000	.0869	.0880	.0896	.0838	.0915	.0870	.0863	.0860	.0879	.0900	.0877	.0863
46,000	.0896	.0900	.0928	.0862	.0940	.0890	.0892	.0889	.0900	.0930	.0903	.0889
47,000	.0918	.0935	.0954	.0890	.0968	.0928	.0926	.0923	.0928	.0952	.0932	.0918
48,000	.0952	.0960	.0980	.0920	.0999	.0949	.0948	.0950	.0955	.0988	.0960	.0946
49,000	.0980	.0980	.1004	.0945	.1025	.0970	.0975	.0974	.0991	.1018	.0986	.0972
50,000	.1018	.1004	.1032	.0970	.1050	.0994	.0994	.1006	.1023	.1051	.1014	.1000
51,000	.1040	.1035	.1065	.0988	.1087	.1034	.1026	.1040	.1041	.1080	.1044	.1030
52,000	.1066	.1070	.1095	.1019	.1125	.1055	.1054	.1073	.1075	.1124	.1076	.1062
53,000	.1095	.1095	.1116	.1050	.1146	.1084	.1082	.1102	.1108	.1138	.1102	.1088
54,000	.1132	.1125	.1144	.1070	.1179	.1116	.1110	.1130	.1140	.1170	.1132	.1118
55,000	.1154	.1145	.1184	.1110	.1214	.1170	.1122	.1165	.1165	.1197	.1163	.1149
56,000	.1166	.1180	.1215	.1134	.1244	.1206	.1160	.1195	.1195	.1230	.1193	.1180
57,000	.1218	.1205	.1235	.1161	.1275	.1214	.1190	.1228	.1225	.1250	.1220	.1207
58,000	.1239	.1233	.1255	.1179	.1330	.1230	.1216	.1245	.1256	.1273	.1246	.1233
59,000	.1272	.1257	.1290	.1210	.1360	.1256	.1242	.1282	.1290	.1305	.1276	.1263
60,000	.1297	.1281	.1318	.1235	.1380	.1281	.1268	.1314	.1319	.1345	.1304	.1291
62,000	.1375	.1373	.1377	.1291	.1429	.1350	.1338	.1369	.1378	.1400	.1368	.1355
64,000	.1435	.1425	.1427	.1350	.1479	.1396	.1390	.1438	.1435	.1452	.1423	.1410
66,000	.1510	.1476	.1483	.1433	.1530	.1451	.1448	.1489	.1486	.1526	.1483	.1470
68,000	.1548	.1525	.1537	.1465	.1589	.1506	.1509	.1550	.1562	.1570	.1536	.1524
70,000	.1588	.1580	.1590	.1520	.1640	.1568	.1571	.1614	.1611	.1625	.1591	.1579
72,000	.1644	.1635	.1645	.1570	.1695	.1619	.1622	.1670	.1657	.1690	.1645	.1633
74,000	.1700	.1688	.1697	.1625	.1758	.1675	.1680	.1718	.1735	.1750	.1703	.1691
76,000	.1755	.1744	.1755	.1679	.1808	.1740	.1743	.1776	.1770	.1789	.1756	.1744
78,000	.1805	.1794	.1810	.1730	.1850	.1781	.1800	.1829	.1817	.1843	.1806	.1794
80,000	.1858	.1844	.1870	.1781	.1900	.1833	.1849	.1881	.1874	.1891	.1858	.1846
82,000	.1900	.1895	.1930	.1839	.1948	.1880	.1906	.1936	.1922	.1949	.1911	.1899
84,000	.1958	.1942	.1965	.1884	.2007	.1940	.1953	.1985	.1969	.2002	.1961	.1951
86,000	.2008	.2000	.2020	.1936	.2049	.1987	.2002	.2035	.2029	.2048	.2011	.2001
88,000	.2070	.2045	.2066	.1982	.2088	.2041	.2050	.2090	.2072	.2098	.2060	.2050
90,000	.2111	.2095	.2115	.2035	.2134	.2080	.2097	.2135	.2120	.2150	.2107	.2097
92,000	.2158	.2140	.2157	.2080	.2185	.2131	.2145	.2180	.2164	.2194	.2153	.2144
94,000	.2195	.2183	.2205	.2125	.2225	.2172	.2190	.2223	.2220	.2243	.2198	.2189
96,000	.2248	.2229	.2250	.2170	.2270	.2226	.2236	.2272	.2256	.2280	.2244	.2235
98,000	.2290	.2275	.2289	.2217	.2315	.2265	.2282	.2315	.2294	.2323	.2287	.2278
100,000	.2330	.2311	.2343	.2255	.2374	.2320	.2315	.2353	.2338	.2370	.2331	.2322

Load per square inch on crusher gauge one-tenth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
62,000	.2645	.2659	.2710	.2690	.2690	.2710	.2688	.2687	.2709	.2711	.2690	.2677
64,000	.2800	.2706	.2765	.2730	.2743	.2770	.2740	.2750	.2756	.2762	.2754	.2741
66,000	.2850	.2750	.2814	.2790	.2796	.2815	.2793	.2794	.2812	.2805	.2802	.2789
68,000	.2905	.2815	.2865	.2840	.2848	.2876	.2840	.2848	.2858	.2852	.2855	.2843
70,000	.2945	.2854	.2906	.2884	.2897	.2919	.2893	.2887	.2905	.2902	.2899	.2887
72,000	.2990	.2906	.2955	.2927	.2940	.2969	.2929	.2935	.2952	.2954	.2946	.2934
74,000	.3030	.2940	.3000	.2980	.2977	.3002	.2970	.2976	.3000	.2990	.2987	.2975
76,000	.3075	.2975	.3035	.3020	.3025	.3041	.3019	.3017	.3030	.3039	.3028	.3016
78,000	.3115	.3015	.3073	.3058	.3060	.3084	.3052	.3054	.3075	.3071	.3066	.3054
80,000	.3150	.3052	.3110	.3095	.3090	.3118	.3091	.3093	.3108	.3110	.3102	.3090
82,000	.3183	.3090	.3140	.3130	.3130	.3155	.3129	.3125	.3142	.3146	.3137	.3125
84,000	.3219	.3124	.3175	.3165	.3171	.3192	.3161	.3159	.3173	.3179	.3172	.3162
86,000	.3250	.3155	.3210	.3203	.3199	.3224	.3198	.3194	.3209	.3216	.3206	.3196
88,000	.3281	.3187	.3240	.3234	.3230	.3252	.3228	.3225	.3243	.3240	.3236	.3226
90,000	.3317	.3216	.3268	.3260	.3258	.3283	.3255	.3250	.3268	.3270	.3265	.3255
92,000	.3340	.3248	.3298	.3281	.3285	.3305	.3290	.3285	.3297	.3304	.3293	.3284
94,000	.3372	.3277	.3322	.3316	.3316	.3335	.3310	.3310	.3330	.3329	.3322	.3313
96,000	.3395	.3306	.3347	.3342	.3340	.3357	.3336	.3336	.3352	.3360	.3347	.3338
98,000	.3418	.3325	.3374	.3371	.3366	.3386	.3362	.3362	.3384	.3379	.3373	.3364
100,000	.3447	.3349	.3400	.33[illegible]	.3392	.3414	.3390	.3388	.3402	.3410	.3396	.3389

Mean compression of 10 cylinders from Frankford Arsenal. Metal purchased May 20, 1901.

Table for use with crusher gauge one-thirtieth square inch area.

Mean dimensions of cylinders: Length, ".4997; diameter, ".2044.

Load per square inch on crusher gauge one-thirtieth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
3,000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6,000	.0005	.0005	.0005	.0005	.0005	.0006	.0007	.0010	.0006	.0007	.0006	.0004
9,000	.0038	.0026	.0028	.0014	.0032	.0027	.0024	.0028	.0034	.0025	.0028	.0023
10,000	.0050	.0044	.0049	.0027	.0049	.0045	.0035	.0042	.0048	.0040	.0043	.0037
11,000	.0069	.0054	.0065	.0042	.0067	.0057	.0051	.0063	.0065	.0055	.0059	.0053
12,000	.0086	.0075	.0084	.0058	.0085	.0075	.0069	.0077	.0084	.0075	.0077	.0070
13,000	.0106	.0091	.0104	.0074	.0104	.0096	.0085	.0098	.0102	.0094	.0095	.0087
14,000	.0129	.0110	.0123	.0089	.0122	.0114	.0104	.0115	.0122	.0114	.0114	.0105
15,000	.0140	.0130	.0142	.0110	.0145	.0135	.0123	.0134	.0143	.0134	.0134	.0124
16,000	.0165	.0150	.0165	.0128	.0164	.0157	.0145	.0155	.0160	.0156	.0155	.0144
17,000	.0182	.0170	.0184	.0150	.0186	.0176	.0162	.0174	.0184	.0173	.0174	.0163
18,000	.0207	.0193	.0209	.0169	.0205	.0202	.0185	.0198	.0207	.0194	.0197	.0186
19,000	.0226	.0215	.0228	.0184	.0224	.0218	.0204	.0216	.0226	.0210	.0215	.0204
20,000	.0249	.0235	.0249	.0206	.0253	.0246	.0225	.0236	.0249	.0238	.0239	.0228
21,000	.0269	.0257	.0272	.0235	.0275	.0263	.0248	.0249	.0274	.0260	.0260	.0249
22,000	.0290	.0279	.0296	.0253	.0300	.0284	.0270	.0267	.0294	.0278	.0281	.0270
23,000	.0320	.0300	.0317	.0275	.0320	.0308	.0291	.0292	.0320	.0308	.0305	.0294
24,000	.0342	.0324	.0340	.0296	.0344	.0330	.0318	.0317	.0342	.0335	.0329	.0317
25,000	.0363	.0345	.0368	.0319	.0366	.0353	.0338	.0340	.0364	.0359	.0352	.0340
26,000	.0388	.0370	.0391	.0340	.0393	.0376	.0362	.0360	.0389	.0383	.0375	.0363
27,000	.0414	.0396	.0419	.0365	.0419	.0405	.0387	.0381	.0415	.0405	.0401	.0389
28,000	.0436	.0420	.0444	.0390	.0440	.0425	.0415	.0400	.0440	.0428	.0424	.0412
29,000	.0462	.0435	.0470	.0410	.0470	.0457	.0438	.0425	.0467	.0460	.0449	.0437
30,000	.0489	.0465	.0493	.0440	.0495	.0478	.0462	.0454	.0489	.0481	.0475	.0463
31,000	.0515	.0495	.0522	.0460	.0520	.0500	.0488	.0479	.0513	.0508	.0500	.0488
32,000	.0540	.0525	.0550	.0485	.0549	.0528	.0510	.0505	.0540	.0535	.0527	.0515
33,000	.0564	.0550	.0573	.0513	.0576	.0554	.0532	.0530	.0560	.0558	.0551	.0539
34,000	.0588	.0568	.0600	.0543	.0602	.0579	.0558	.0550	.0580	.0585	.0575	.0563
35,000	.0620	.0596	.0615	.0565	.0630	.0604	.0584	.0580	.0617	.0621	.0603	.0589
36,000	.0645	.0626	.0646	.0590	.0662	.0630	.0615	.0609	.0640	.0640	.0630	.0616
37,000	.0665	.0652	.0676	.0616	.0687	.0660	.0639	.0635	.0672	.0680	.0658	.0644

WHEELS AND AXLE OF A 75-MILLIMETER MOUNTAIN-GUN CARRIAGE.

The wheels were loaded by pressure applied at their rims, acting in an inward direction. The reduction in the gauge of the wheels was determined under successively increased loads and the deflection of the axle observed at the middle of its length, as shown by the accompanying photograph. After the test the condition of the wheels is shown by the second photograph herewith.

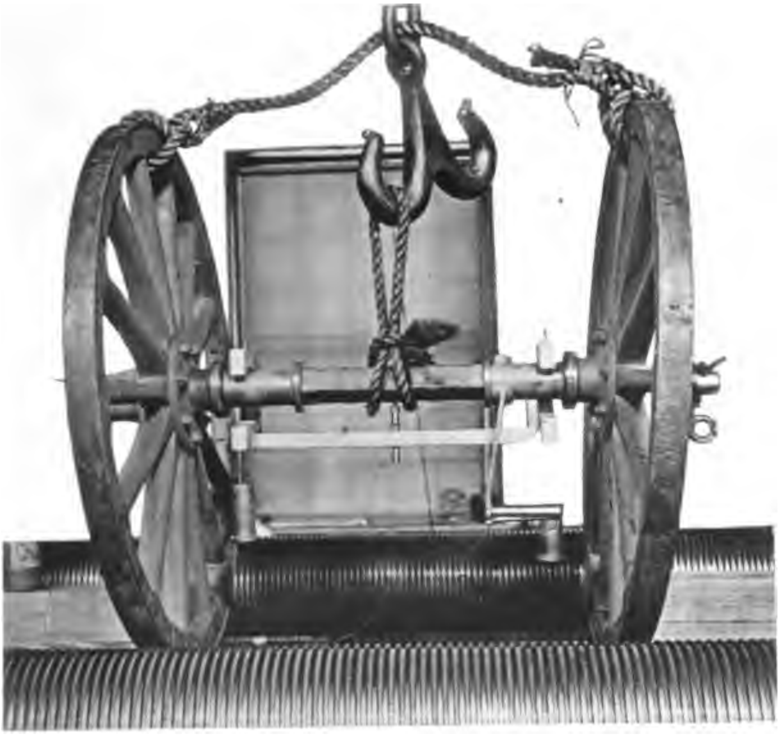
TEST OF WHEELS AND AXLE FOR A 75-MILLIMETER MOUNTAIN-GUN CARRIAGE.

Applied loads.	Reduction in gauge.	Deflection of axle.	Remarks.
Pounds.	*Inches.*	*Inch.*	
300	0.	0.	Initial load.
400	.07	.003	
500	.14	.006	
600	.20	.007	
700	.28	.010	
800	.37	.012	
900	.47	.014	
1,000	.53	.017	
1,100	.62	.019	
1,200	.72	.022	
1,300	.81	.025	Rested one-half hour.
1,400	.91	.028	
1,500	1.00	.030	
1,600	1.10	.032	
1,700	1.20	.035	
1,800	1.30	.037	
1,900	1.42	.039	
2,000	1.53	.041	
2,100	1.65	.045	
2,200	1.78	.047	
2,300	1.93	.050	
2,400	2.05	.052	
2,500	2.20	.054	
2,600	2.36	.057	
2,700	2.57	.060	Spokes disturbed at hub.
2,800	2.77	.063	
4,100	....	....	Ultimate strength.

Fractured two spokes at the hub and one spoke at tenon at the felloe. Bent the inner flange of the hub. Axle permanently deflected along the middle of its length. Hubs worked freely on journals after the test.

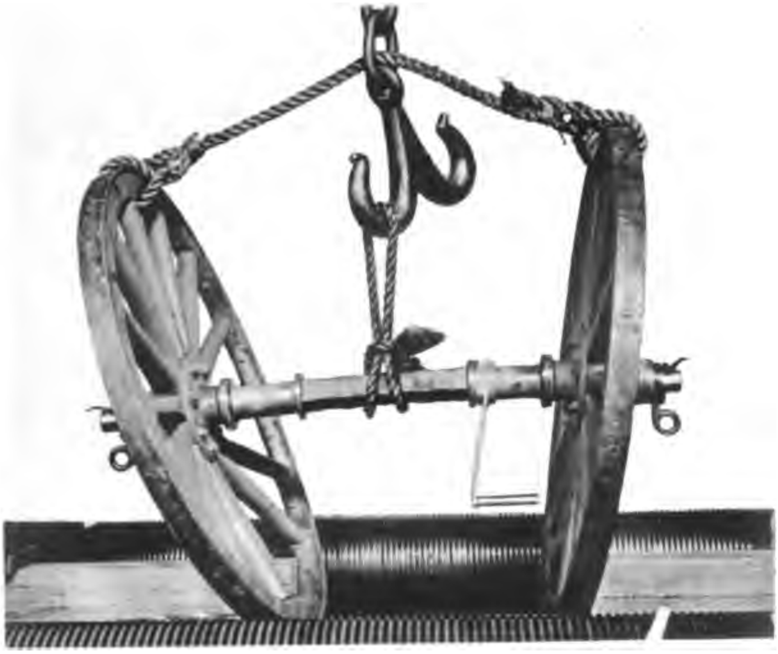
New wheels were placed on the axle after the test, and their gauge measured at bottom 2′-2½″, as against 2′-3⅜″, the gauge of a new finished axle, showing a difference of ⅞″.

The deflection of the axle was such that the gauge of the wheels was a minimum on the front quarter.



75 M-M MOUNTAIN GUN CARRIAGE WHEELS AND AXLE, APPEARANCE AT COMMENCEMENT OF THE TEST, DEFLECTION BAR AND MICROMETER IN POSITION.

HELIOTYPE CO., BOSTON.



75 M-M MOUNTAIN GUN CARRIAGE WHEELS AND AXLE, APPEARANCE AT THE END OF THE TEST, SHOWING MANNER OF FAILURE.

HELIOTYPE CO., BOSTON.

62-INCH CARBON STEEL INGOT.

CHEMICAL COMPOSITION.

Carbon	.58
Manganese	.73
Silicon	.20
Phosphorus	.028
Sulphur	.023

METAL FROM 62-INCH OCTAGONAL CARBON-STEEL INGOT.

Forged specimens—square bars drawn down to square bars, forged and treated at different temperatures.

Original dimensions of specimens, 1⅝″ by 1⅝″ by 12″ long. Drawn down to about 1″ square.

No. 8015.

Heated low forging heat, dark salmon (expansion, ″.222 in 12″.502), and drawn down under the hammer. Reduction, 59.1 per cent.

Cooled in sand.

Marks, 1*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
20,000	.0018	....	
30,000	.0028	0.	
35,000	.0033	....	
40,000	.0039	0.	
45,000	.0044	....	
50,000	.0049	0.	
55,000	.0055	....	
57,000	.0057	....	
57,500	....	....	Elastic limit. Load fell.
53,000	.0075	....	
54,000	.0089	....	
55,000	.0135	....	
56,000	.0285	....	
57,000	.0301	....	
58,000	.0322	....	
59,000	.0341	....	
60,000	.0365	....	
62,000	.0415	....	
64,000	.0460	....	
66,000	.0515	....	
68,000	.0572	....	
70,000	.0630	....	
72,000	.0690	....	
76,000	.0826′	....	
80,000	.0990	....	
84,000	.1180	....	
88,000	.1419	....	
92,000	.18	....	
96,000	.23	....	
99,840	.44	....	Tensile strength.
0	.64	....	=21.3 per cent.

Elongation of inch sections, ″.25*, ″.26*, ″.13.

Diameter at fracture, ″.43; area, .1452 square inch.

Contraction of area, 41.9 per cent.

Appearance of fracture, fine silky.

No. 8016.

Heated low forging heat (expansion, ″.222 in 12″.502) and drawn down under the hammer. Reduction, 57.6 per cent.

Cooled in sand.

Annealed at blood red.

Marks, 1**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0029	0.	
40,000	.0040	....	
45,000	.0045	....	
50,000	.0050	0.	
55,000	.0055	....	
56,000	.0056	....	Elastic limit. Load fell.
52,000	.0072	....	
53,000	.0105	....	
54,000	.0308	....	
55,000	.0317	....	
56,000	.0335	....	
57,000	.0355	....	
58,000	.0382	....	
60,000	.0439	....	
62,000	.0490	....	
64,000	.0550	....	
68,000	.0668	....	
72,000	.0810	....	
76,000	.0982	....	
80,000	.1184	....	
84,000	.1440	....	
88,000	.17	....	
92,000	.23	....	
96,000	.40	....	Tensile strength.
0	.64	....	=21.3 per cent.

Elongation of inch sections, ″.35*, ″.17, ″.12.

Diameter at fracture, ″.41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, fine silky.

No. 8017.

Heated low forging heat (expansion, ″.222 in 12″.505) and drawn down under the hammer. Reduction, 58 per cent.

Cooled in sand.

Annealed at low cherry.

Marks, 1***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0027	0.	
40,000	.0037	....	
45,000	.0042	....	
50,000	.0047	0.	
55,000	.0052	....	
56,000	.0053	....	Elastic limit. Load fell.
51,000	.0087	....	
52,000	.0144	....	
53,000	.0317	....	
54,000	.0335	....	
55,000	.0350	....	
56,000	.0372	....	
58,000	.0430	....	
60,000	.0481	....	
62,000	.0541	....	
64,000	.0602	....	
68,000	.0745	....	
72,000	.0906	....	
76,000	.1078	....	
80,000	.1315	....	
84,000	.15	....	
88,000	.20	....	
92,000	.30	....	
94,000	.42	....	Tensile strength.
0	.75	....	= 25 per cent.

Elongation of inch sections, ″.29*, ″.31*, ″.15.

Diameter at fracture, ″.42; area, .1386 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, fine silky.

No. 8018.

Heated low forging heat (expansion, ″.224 in 12″.504) and drawn down under the hammer. Reduction, 59.5 per cent.

Cooled in sand.

Annealed at full cherry.

Marks, 2*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0043	....	
50,000	.0048	0.	
51,000	.0050	....	
52,000	....	....	Elastic limit. Load fell.
48,000	.0065	....	
49,000	.0070	....	
50,000	.0168	....	
51,000	.0205	....	
52,000	.0245	....	
53,000	.0260	....	
54,000	.0286	....	
56,000	.0332	....	
58,000	.0375	....	
60,000	.0424	....	
64,000	.0538	....	
68,000	.0650	....	
72,000	.0780	....	
76,000	.0946	....	
80,000	.1132	....	
84,000	.1365	....	
88,000	.17	....	
92,000	.23	....	
95,000	.37	....	Tensile strength.
0	.57	....	=19 per cent.

Elongation of inch sections, ″.36*, ″.12, ″.09.

Diameter at fracture, ″.40; area, .1257 square inch.

Contraction of area, 49.7 per cent.

Appearance of fracture, fine silky.

No. 8019.

Heated low forging heat (expansion, ″.224 in 12″.504) and drawn down under the hammer. Reduction, 58.7 per cent.

Cooled in sand.

Annealed at low yellow.

Marks, 2**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	,0029	0.	
40,000	.0040	....	
45,000	.0045	....	
50,000	.0050	0.	
51,000	.0052	....	
52,000	.0053	....	
53,000	.0054	....	
56,000	.0057	....	
57,000	.0058	....	Elastic limit. Load fell.
54,000	.0062	....	
55,000	.0257	....	
56,000	.0420	....	
57,000	.0446	....	
58,000	.0465	....	
60,000	.0518	....	
64,000	.0640	....	
68,000	.0790	....	
72,000	.0935	....	
76,000	.1154	....	
80,000	.1400	....	
84,000	.18	....	
88,000	.23	....	
92,000	.36	....	
92,400	.42	....	Tensile strength.
0	.67	....	=22.3 per cent.

Elongation of inch sections, ″.20, ″.36*, ″.11.

Diameter at fracture, ″.41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, fine silky.

No. 8020.

Heated low forging heat (expansion, ″.224 in 12″.504) and drawn down under the hammer. Reduction, 58.7 per cent.

Cooled in sand.

Annealed at bright yellow.

Marks, 2***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0043	....	
50,000	.0048	0.	
51,000	.0049	....	
51,800	....	....	Elastic limit. Load fell.
48,000	.0075	....	
49,000	.0117	....	
50,000	.0207	....	
51,000	.0224	....	
52,000	.0243	....	
54,000	.0287	....	
56,000	.0332	....	
58,000	.0375	....	
60,000	.0433	....	
64,000	.0553	....	
68,000	.0673	....	
72,000	.0815	....	
76,000	.0980	....	
80,000	.1185	....	
84,000	.15	....	
88,000	.18	....	
92,000	.24	....	
95,000	.42	....	Tensile strength.
0	.66	....	=22 per cent.

Elongation of inch sections, ″.13, ″.32*, ″.21.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, fine silky.

No. 8021.

Heated low forging heat (expansion, ″.224 in 12″.501) and drawn down under the hammer. Reduction, 61 per cent.

Cooled in sand.

Annealed at white heat.

Marks, 3*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0029	0.	
40,000	.0041	.0001	
43,000	.0044	....	
44,000	.0046	....	Elastic limit.
45,000	.0049	....	
46,000	.0056	....	
47,000	.0064	....	
48,000	.0078	....	
49,000	.0088	....	
50,000	.0102	.0047	
52,000	.0126	....	
54,000	.0167	....	
56,000	.0201	....	
58,000	.0240	....	
60,000	.0279	.0205	
64,000	.0367	....	
68,000	.0461	....	
72,000	.0565	....	
76,000	.0686	....	
80,000	.0808	....	
84,000	.0932	....	
88,000	.11	....	
92,000	.13	....	
96,000	.17	....	
100,000	.22	....	
103,120	.37	....	Tensile strength.
0	.46	....	-15.3 per cent.

Elongation of inch sections, ″.23*, ″.14, ″.09.

Diameter at fracture, ″.47; area, .1735 square inch.

Contraction of area, 30.6 per cent.

Appearance of fracture, granular, silky center.

No. 8022.

Heated high forging heat, light salmon (expansion, ″.237 in 12″.502), and drawn down under the hammer. Reduction, 61 per cent.

Cooled in sand.

Marks, 6*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0039	....	
45,000	.0044	....	
50,000	.0050	0.	
55,000	.0057	....	Elastic limit.
56,000	.0060	....	
	.0172	....	
57,000	.0189	....	
58,000	.0205	....	
59,000	.0226	....	
60,000	.0246	....	
62,000	.0285	....	
64,000	.0336	....	
68,000	.0421	....	
72,000	.0520	....	
76,000	.0622	....	
80,000	.0748	....	
84,000	.0866	....	
88,000	.1005	....	
92,000	.1225	....	
96,000	.15	....	
100,000	.18	....	
104,000	.26	....	
106.000	.40	....	Tensile strength.
0	.55	....	=18.3 per cent.

Elongation of inch sections, ″.14 ,″.31*, ″.10.

Diameter at fracture, ″.44; area, .1521 square inch.

Contraction of area, 39.2 per cent.

Appearance of fracture, silky, in part fine granular.

No. 8023.

Heated high forging heat (expansion, ″.237 in 12″.502) and drawn down under the hammer. Reduction, 59.8 per cent.

Cooled in sand.

Annealed at blood red.

Marks, 6**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0029	0.	
40,000	.0039	....	
45,000	.0044	....	
50,000	.0050	0.	
54,000	.0055	....	Elastic limit.
55,000	.0063	....	Load fell.
54,000	.0069	....	
55,000	.0085	....	
56,000	.0189	....	
57,000	.0198	....	
58,000	.0216	....	
60,000	.0258	....	
62,000	.0303	....	
64,000	.0340	....	
68,000	.0432	....	
72,000	.0526	....	
76,000	.0630	....	
80,000	.0740	....	
84,000	.0862	....	
88,000	.1018	....	
92,000	.1202	....	
96,000	.15	....	
100,000	.18	....	
104,000	.26	....	
106,080	.39	....	Tensile strength.
....	.51	....	= 17 per cent.

Elongation of inch sections, ″.24*, ″.17, ″.10.

Diameter at fracture, ″.46; area, .1662 square inch.

Contraction of area, 33.5 per cent.

Appearance of fracture, fine granular, silky spot at the circumference.

No. 8024.

Heated high forging heat (expansion, ″.237 in 12″.502) and drawn down under the hammer. Reduction, 60.6 per cent.

Cooled in sand.

Annealed at low cherry.

Marks, 6***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0030	0.	
40,000	.0040	....	
45,000	.0045	....	
50,000	.0051	0.	
54,000	.0056	....	Elastic limit.
55,000	.0064	....	
	.0113	....	
56,000	.0180	....	
57,000	.0190	....	
58,000	.0213	....	
60,000	.0259	....	
62,000	.0300	....	
64,000	.0331	....	
68,000	.0421	....	
72,000	.0524	....	
76,000	.0615	....	
80,000	.0731	....	
84,000	.0859	....	
88,000	.1008	....	
92,000	.1204	....	
96,000	.15	....	
100,000	.18	....	
104,000	.23	....	
106,400	.40	....	Tensile strength.
0	.53	....	=17.7 per cent.

Elongation of inch sections, ″.28*, ″.15, ″.10.

Diameter at fracture, ″.46; area, .1662 square inch.

Contraction of area, 33.5 per cent.

Appearance of fracture, fine granular, silky spot at circumference

No. 8025.

Heated high forging heat (expansion, ″.237 in 12″.500) and drawn down under the hammer. Reduction, 59.8 per cent.

Cooled in sand.

Annealed at full cherry.

Marks, 7*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0	
10,000	.0009		
30,000	.0029	0.	
40,000	.0039		
45,000	.0045		
50,000	.0052 .0288		Elastic limit.
51,000	.0309		
52,000	.0328		
53,000	.0350		
54,000	.0378		
56,000	.0434		
58,000	.0490		
60,000	.0545		
64,000	.0665		
68,000	.0809		
72,000	.0964		
76,000	.1164		
80,000	.15		
84,000	.18		
88,000	.24		
92,000	.44		Tensile strength.
0	.70		=23.3 per cent.

Elongation of inch sections, ″.13, ″.42*, ″.15.

Diameter at fracture, ″.39; area, .1194 square inch.

Contraction of area, 52.2 per cent.

Appearance of fracture, fine silky.

No. 8026.

Heated high forging heat (expansion, ″.237 in 12″.500) and drawn down under the hammer. Reduction, 59.5 per cent.

Cooled in sand.

Annealed at low yellow.

Marks, 7**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009		
30,000	.0029	0.	
40,000	.0039		
45,000	.0044		
50,000	.0049	0.	
55,000	.0054		
60,000	.0059	.0001	
62,000	.0061		
62,400			Elastic limit. Load fell.
56,000	.0098		
57,000	.0121		
58,000	.0420		
59,000	.0430		
60,000	.0447		
62,000	.0504		
64,000	.0554		
66,000	.0609		
68,000	.0665		
72,000	.0810		
76,000	.0985		
80,000	.1190		
84,000	.15		
88,000	.18		
92,000	.23		
96,000	.35		
96,400	.41		Tensile strength.
0	.63		=21 per cent.

Elongation of inch sections, ″.28*, ″.20*, ″.15.

Diameter at fracture, ″.47; area, .1735 square inch.

Contraction of area, 30.6 per cent.

Appearance of fracture, fine silky.

No. 8027.

Heated high forging heat (expansion, ″.237 in 12″.500) and drawn down under the hammer. Reduction, 59.1 per cent.

Cooled in sand.

Annealed at bright yellow.

Marks, 7***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0029	0.	
40,000	.0039	....	
45,000	.0044	....	
50,000	.0049	0.	
53,000	.0052	....	Elastic limit.
54,000	.0072	....	Load fell.
51,000	.0078	....	
52,000	.0142	....	
53,000	.0241	....	
54,000	.0306	....	
56,000	.0339	....	
58,000	.0396	....	
60,000	.0440	....	
64,000	.0560	....	
68,000	.0678	....	
72,000	.0837	....	
76,000	.0994	....	
80,000	.1196	....	
84,000	.15	....	
88,000	.18	....	
92,000	.24	....	
96,000	.44	....	Tensile strength.
0	.64	....	=21.3 per cent.

Elongation of inch sections, ″.12, ″.35*, ″.17.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, fine silky.

No. 8028.

Heated high forging heat (expansion, ″.232 in 12″.506) and drawn down under the hammer. **Reduction 61.4 per cent.**

Cooled in sand.

Annealed at white heat.

Marks, 8*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	....	
40,000	.0038	....	
44,000	.0043	....	Elastic limit.
45,000	.0054	....	
46,000	.0078	....	
47,000	.0091	....	
48,000	.0112	....	
49,000	.0128	....	
50,000	.0145	....	
52,000	.0190	....	
54,000	.0231	....	
56,000	.0275	....	
60,000	.0367	....	
64,000	.0488	....	
68,000	.0567	....	
72,000	.0698	....	
76,000	.0837	....	
80,000	.1022	....	
84,000	.13	....	
88,000	.15	....	
92,000	.19	....	
96,000	.26	....	
97,200	.34	....	Tensile strength.
0	.49	....	= 16.3 per cent.

Elongation of inch sections, ″.10, ″.10, ″.29*.

Diameter at fracture, ″.46; area, .1662 square inch.

Contraction of area, 33.5 per cent.

Appearance of fracture, granular, 60 per cent; silky center, 40 per cent.

No. 8029.

Heated low forging heat (expansion, ".202 in 12".504) and drawn down under the hammer. Reduction, 58.7 per cent.

Reheated to initial forging temperature and cooled in sand.

Marks, 11*.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0029	0.	
40,000	.0039	....	
45,000	.0044	....	
48,000	.0048	....	Elastic limit.
49,000	.0063	....	Lead fall.
48,000	.0073	....	
49,000	.0114	....	
50,000	.0152	....	
51,000	.0167	....	
52,000	.0192	....	
54,000	.0236	....	
56,000	.0275	....	
58,000	.0315	....	
60,000	.0364	....	
64,000	.0471	....	
68,000	.0564	....	
72,000	.0684	....	
76,000	.0826	....	
80,000	.0980	....	
84,000	.1170	....	
88,000	.15	....	
92,000	.18	....	
96,000	.24	....	
98,560	.37	....	Tensile strength.
0	.62	....	=20.7 per cent.

Elongation of inch sections, ".20, ".29*, ".13.

Diameter at fracture, ".43; area, .1452 square inch.

Contraction of area, 41.9 per cent.

Appearance of fracture, silky.

No. 8030.

Heated low forging heat (expansion, ″.202 in 12″.504) and drawn down under the hammer. Reduction, 58 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at blood red.

Marks, 11**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0043	....	
48,000	.0046	....	Elastic limit. Load fell.
47,000	.0063	....	
48,000	.0110	....	
49,000	.0174	....	
50,000	.0195	....	
51,000	.0212	....	
52,000	.0240	....	
54,000	.0285	....	
56,000	.0326	....	
58,000	.0370	....	
60,000	.0435	....	
64,000	.0538	....	
68,000	.0655	....	
72,000	.0790	....	
76,000	.0946	....	
80,000	.1140	....	
84,000	.14	....	
88,000	.18	....	
92,000	.24	....	
95,760	.39	....	Tensile strength.
0	.61	....	=20.3 per cent.

Elongation of inch sections, ″.35*, ″.15, ″.11.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, silky.

No. 8031.

Heated low forging heat (expansion, ″.202 in 12″.504) and drawn down under the hammer. Reduction, 58 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at low cherry.

Marks, 11***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0029	0.	
40,000	.0039	....	
45,000	.0044	....	
48,000	.0048	....	Elastic limit. Load fell.
46,000	.0065	....	
47,000	.0098	....	
48,000	.0182	....	
49,000	.0195	....	
50,000	.0222	....	
52,000	.0271	....	
54,000	.0310	....	
56,000	.0359	....	
58,000	.0406	....	
60,000	.0460	....	
64,000	.0566	....	
68,000	.0696	....	
72,000	.0845	....	
76,000	.1010	....	
80,000	.1220	....	
84,000	.15	....	
88,000	.19	....	
92,000	.26	....	
94,120	.37 .50	....	Tensile strength.
0	.70	....	=23.3 per cent.

Elongation of inch sections, ″.36*, ″.17, ″.17.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, silky.

No. 8032.

Heated to a low forging heat (expansion, ″.207 in 12″.503) and drawn down under the hammer. Reduction, 60.6 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at full cherry.

Marks, 12*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0028	0.	
40,000	.0039	....	
45,000	.0044	....	
46,000	.0046	....	Elastic limit.
47,000	.0058	....	
48,000	.0132	....	
49,000	.0165	....	
50,000	.0190	....	
52,000	.0232	....	
54,000	.0273	....	
56,000	.0312	....	
58,000	.0360	....	
60,000	.0411	....	
64,000	.0514	....	
68,000	.0635	....	
72,000	.0750	....	
76,000	.0905	....	
80,000	.1073	....	
84,000	.1290	....	
88,000	.16	....	
92,000	.20	....	
96,000	.30	....	
97,200	.44	....	Tensile strength.
0	.66	....	= 22 per cent.

Elongation of inch sections, ″.14, ″.33*, ″.19.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, .44.6 per cent.

Appearance of fracture, silky.

No. 8033.

Heated low forging heat (expansion, ″.207 in 12″.503) and drawn down under the hammer. Reduction, 58.7 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at low yellow.

Marks, 12**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008		
30,000	.0028	0.	
40,000	.0038		
45,000	.0043		
48,000	.0047		
50,000	.0049	0.	
53,000	.0052		
55,000	.0054		
56,000	.0055		
56,200			Elastic limit. Load fell.
52,000	.0090		
53,000	.0355		
54,000	.0371		
55,000	.0380		
56,000	.0412		
58,000	.0456		
60,000	.0520		
64,000	.0645		
68,000	.0780		
72,000	.0935		
76,000	.1140		
80,000	.1415		
84,000	.18		
88,000	.23		
92,000	.37		
92,480	.42		Tensile strength.
0	.75		= 25 per cent.

Elongation of inch sections, ″.16, ″.42*, ″.17.

Diameter of fracture, ″.40; area, .1257 square inch.

Contraction of area, 49.7 per cent.

Appearance of fracture, silky.

No. 8034.

Heated low forging heat (expansion, ″.207 in 12″.503) and drawn down under the hammer. Reduction, 58 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at full yellow.

Marks, 12***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008		
30,000	.0028	0.	
40,000	.0039		
45,000	.0044		
50,000	.0050	0.	
51,000	.0051		Elastic limit.
52,000	.0070		Load fell.
48,000	.0073		
49,000	.0077		
50,000	.0107		
51,000	.0178		
52,000	.0266		
54,000	.0311		
56,000	.0353		
58,000	.0399		
60,000	.0452		
64,000	.0567		
68,000	.0698		
72,000	.0839		
76,000	.1011		
80,000	.1233		
84,000	.15		
88,000	.20		
92,000	.27		
93,360	.34		Tensile strength.
	.45		
0	.61		−20.3 per cent.

Elongation of inch sections, ″.35*, ″.16, ″.10.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, fine silky.

No. 8035.

Heated high forging heat (expansion, ″.203 in 12″.503) and drawn down under the hammer. Reduction, 61 per cent.

Reheated to initial forging temperature and cooled in sand.

Marks, 16*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0044	....	
50,000	.0051	.0002	Elastic limit.
51,000	.0055	....	
52,000	.0060	....	
53,000	.0074	....	
54,000	.0128	....	
56,000	.0175	....	
58,000	.0212	....	
60,000	.0251	....	
64,000	.0322	....	
68,000	.0404	....	
72,000	.0504	....	
76,000	.0603	....	
80,000	.0710	....	
84,000	.0835	....	
88,000	.0968	....	
92,000	.1138	....	
96,000	.1401	....	
100,000	.16	....	
104,000	.21	....	
107,200	.36	....	Tensile strength.
0	.46	....	=15.3 per cent.

Elongation of inch sections, ″.27*, ″.10, ″.09.

Diameter at fracture, ″.45; area, .1590 square inch.

Contraction of area, 36.4 per cent.

Appearance of fracture, granular, 50 per cent; silky center, 50 per cent.

No. 8036.

Heated high forging heat (expansion, ″.203 in 12″.503) and drawn down under the hammer. Reduction, 59.5 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at blood red.

Marks, 16**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0043	....	
50,000	.0049	0.	
52,000	.0051	....	Elastic limit.
53,000	.0055	....	
54,000	.0148	....	
55,000	.0166	....	
56,000	.0187	....	
58,000	.0224	....	
60,000	.0260	....	
64,000	.0350	....	
68,000	.0430	....	
72,000	.0525	....	
76,000	.0619	....	
80,000	.0730	....	
84,000	.0852	....	
88,000	.1003	....	
92,000	.1182	....	
96,000	.1417	....	
100,000	.18	....	
104,000	.23	....	
106,400	.37	....	Tensile strength.
0	.52	....	=17.3 per cent.

Elongation of inch sections, ″.13, ″.28*, ″.11.

Diameter at fracture, ″.46; area, .1662 square inch.

Contraction of area, 33.5 per cent.

Appearance of fracture, granular, 60 per cent; silky, 40 per cent.

No. 8037.

Heated high forging heat (expansion, ″.203 in 12″.503) and drawn down under the hammer. Reduction, 59.8 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at low cherry.

Marks, 16***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0029	0.	
40,000	.0039	....	
45,000	.0044	....	
49,000	.0050	....	
50,000	.0052	.0001	Elastic limit.
51,000	.0055	....	
52,000	.0131	....	
53,000	.0154	....	
54,000	.0176	....	
56,000	.0216	....	
58,000	.0266	....	
60,000	.0298	....	
64,000	.0378	....	
68,000	.0477	....	
72,000	.0565	....	
76,000	.0673	....	
80,000	.0798	....	
84,000	.0932	....	
88,000	.1094	....	
92,000	.1285	....	
96,000	.1560	....	
100,000	.20	....	
104,000	.30	....	
105,200	.42	....	Tensile strength.
0	.49	....	= 16.3 per cent.

Elongation of inch sections, ″.19*, ″.18*, ″.12.

Diameter at fracture, ″.48; area, .1810 square inch.

Contraction of area, 27.6 per cent.

Appearance of fracture, granular, silky spot at circumference.

No. 8038.

Heated high forging heat (expansion, ″.207 in 12″.498) and drawn down under the hammer. Reduction, 61.4 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at full cherry.

Marks, 17*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008		
30,000	.0029	0.	
40,000	.0042	.0003	Elastic limit.
41,000	.0051		
42,000	.0061		
43,000	.0073		
44,000	.0085		
46,000	.0111		
48,000	.0159		
50,000	.0233		
52,000	.0340		
56,000	.0450		
60,000	0562		
64,000	.0694		
68,000	.0825		
72,000	.1025		
76,000	.1245		
80,000	.16		
84,000	.20		
88,000	.27		
89,680	.42		Tensile strength.
0	.55		= 18.3 per cent.

Elongation of inch sections, ″.35*, ″.11, ″.09.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, granular, 50 per cent; silky center, 50 per cent.

No. 8039.

Heated high forging heat (expansion, ″.207 in 12″.498) and drawn down under the hammer. Reduction, 60.6 per cent.

Reheated to initial forging heat and cooled in sand.

Annealed at low yellow.

Marks, 17**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0030	0.	
40,000	.0040	....	
45,000	.0045	....	
50,000	.0052	0.	
54,000	.0055	....	
55,000	.0057	....	
56,000	.0059	....	
57,000	.0060	....	Elastic limit.
58,000	.0100	....	Load fell.
52,000	.0155	....	
53,000	.0177	....	
54,000	.0390	....	
55,000	.0410	....	
56,000	.0429	....	
58,000	.0475	....	
60,000	.0534	....	
64,000	.0661	....	
68,000	.0810	....	
72,000	.0986	....	
76,000	.1186	....	
80,000	.1456	....	
84,000	.19	....	
88,000	.24	....	
92,000	.37	....	Tensile strength.
	.48	....	
0	.71	....	=23.7 per cent.

Elongation of inch sections, ″.25,″.32*, ″.14.

Diameter at fracture, ″.41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, fine silky.

No. 8040.

Heated high forging heat (expansion, ".207 in 12".498) and drawn down under the hammer. Reduction, 61.4 per cent.

Reheated to initial forging temperature and cooled in sand.

Annealed at bright yellow.

Marks, 17***.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0029	0.	
40,000	.0039	....	
45,000	.0044	....	
50,000	.0049	0.	
55,000	.0054	....	
55,200	....	....	Elastic limit. Load fell.
50,000	.0172	....	
51,000	.0210	....	
52,000	.0305	....	
53,000	.0358	....	
54,000	.0378	....	
56,000	.0422	....	
58,000	.0477	....	
60,000	.0542	....	
64,000	.0672	....	
68,000	.0815	....	
72,000	.0905	....	
76,000	.1217	....	
80,000	.15	....	
84,000	.19	....	
88,000	.25	....	
91,520	.41	....	Tensile strength.
0	.71	....	= 23.7 per cent.

Elongation of inch sections, ".19, ".39*, ".13.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, fine silky.

No. 8042.

Heated low forging heat (expansion, ″.224 in 12″.501) and drawn down under the hammer. Reduction, 58.7 per cent.

Cooled in sand.

Marks, 3**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0043	....	
50,000	.0049	0.	
53,000	.0051	....	Elastic limit. Load fell.
50,000	.0198	....	
51,000	.0275	....	
52,000	.0293	....	
53,000	.0298	....	
54,000	.0311	....	
56,000	.0364	....	
58,000	.0415	....	
60,000	.0470	....	
64,000	.0594	....	
68,000	.0718	....	
72,000	.0857	....	
76,000	.1027	....	
80,000	.1255	....	
84,000	.15	....	
88,000	.20	....	
92,000	.26	....	
94,560	.40	....	Tensile strength.
0	.61	....	= 20.3 per cent.

Elongation of inch sections, ″.23*, ″.27*, ″.11.

Diameter at fracture, ″.43; area, .1452 square inch.

Contraction of area, 41.9 per cent.

Appearance of fracture, fine silky.

No. 8043.

Heated low forging heat (expansion ″.222 in 12″.504) and drawn down under the hammer. Reduction, 60.6 per cent.

Cooled in sand.

Marks, 4****.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0043	....	
50,000	.0048	0.	
54,000	.0054	....	
56,000	.0056	....	
56,800	....	....	Elastic limit. Load fell.
51,000	.0094	....	
52,000	.0226	....	
53,000	.0280	....	
54,000	.0317	....	
56,000	.0362	....	
58,000	.0410	....	
60,000	.0470	....	
64,000	.0585	....	
68,000	.0718	....	
72,000	.0876	....	
76,000	.1062	....	
80,000	.1280	....	
84,000	.16	....	
88,000	.20	....	
92,000	.28	....	
94,000	.39	....	Tensile strength.
0	.73	....	= 24.3 per cent.

Elongation of inch sections, ″.16, ″.41*, ″.16.

Diameter at fracture, ″.41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, fine silky.

No. 8044.

Heated high forging heat (expansion, ″.232 in 12″.506) and drawn down under the hammer. Reduction, 60.6 per cent.

Cooled in sand.

Marks, 8**.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0044	....	
50,000	.0051	.0001	
50,200	....	....	Elastic limit. Load fell.
48,000	.0132	....	
49,000	.0169	....	
50,000	.0200	....	
51,000	.0215	....	
52,000	.0236	....	
54,000	.0289	....	
56,000	.0317	....	
58,000	.0372	....	
60,000	.0418	....	
64,000	.0536	....	
68,000	.0650	....	
72,000	.0794	....	
76,000	.0954	....	
80,000	.1140	....	
84,000	.1370	....	
88,000	.18	....	
92,000	.23	....	
94,000	.30	....	
95,200	.37	....	Tensile strength.
0	.60	....	= 20 per cent.

Elongation of inch sections, ″.12, ″.27*, ″.21.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, silky, interspersed with fine granulation at circumference.

No. 8045.

Heated high forging heat (expansion, ″.239 in 12″.503) and drawn down under the hammer. Reduction, 59.5 per cent.

Cooled in sand.

Marks, 9****.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0039	....	
45,000	.0044	....	
49,000	.0049	....	Elastic limit.
50,000	.0062	....	Load fell.
48,000	.0068	....	
49,000	.0092	....	
50,000	.0230	....	
51,000	.0242	....	
52,000	.0263	....	
54,000	.0310	....	
56,000	.0350	....	
58,000	.0405	....	
60,000	.0460	....	
64,000	.0585	....	
68,000	.0695	....	
72,000	.0839	....	
76,000	.1017	....	
80,000	.1240	....	
84,000	.1500	....	
88,000	.20	....	
92,000	.27	....	
94,000	.37	....	Tensile strength.
0	.60	....	–20 per cent.

Elongation of inch sections, ″.11, ″.17, ″.32*.

Diameter at fracture, ″.41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, fine silky.

No. 8046.

Heated low forging heat (expansion, ″.224 in 12″.506) and drawn down under the hammer. Reduction, 60.6 per cent.

Reheated to initial forging temperature and cooled in sand.

Marks, 13*.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0039	....	
45,000	.0044	....	
47,000	.0046	....	Elastic limit.
48,000	.0053 .0090	....	
49,000	.0122	....	
50,000	.0169	....	
51,000	.0186	....	
52,000	.0211	....	
54,000	.0255	....	
56,000	.0295	....	
58,000	.0341	....	
60,000	.0388	....	
64,000	.0490	....	
68,000	.0602	....	
72,000	.0724	....	
76,000	.0865	....	
80,000	.1028	....	
84,000	.1238	....	
88,000	.16	....	
92,000	.20	....	
96,000	.27	....	
97,290	.37 .43	....	Tensile strength.
0	.60	....	=20 per cent.

Elongation of inch sections, ″.33*, ″.14, ″.13.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, fine silky.

No. 8047.

Heated low forging heat (expansion, ″.205 in 12″.506) and drawn down under the hammer. Reduction, 59.5 per cent.

Reheated to initial forging temperature and cooled in sand.

Marks, 14***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	....	
45,000	.0044	....	Elastic limit.
46,000	.0084	....	
47,000	.0155	....	
48,000	.0175	....	
49,000	.0185	....	
50,000	.0214	....	
52,000	.0254	....	
54,000	.0298	....	
56,000	.0314	....	
58,000	.0392	....	
60,000	.0446	....	
64,000	.0560	....	
68,000	.0680	....	
72,000	.0815	....	
76,000	.0978	....	
80,000	.1178	....	
84,000	.1445	....	
88,000	.19	....	
92,000	.25	....	
94,960	.42	....	Tensile strength.
0	.59	....	= 19.7 per cent.

Elongation of inch sections, ″.32*, ″.15, ″.12.

Diameter at fracture, ″.44; area, .1521 square inch,

Contraction of area, 39.2 per cent.

Appearance of fracture, fine silky,

No. 8048.

Heated high forging heat (expansion, ".207 in 12".498) and drawn down under the hammer. Reduction, 61 per cent.

Reheated to initial forging temperature and cooled in sand.

Marks, 17****.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0039	....	
44,000	.0043	....	Elastic limit.
45,000	.0054	....	
46,000	.0083	....	
47,000	.0100	....	
48,000	.0118	....	
49,000	.0138	....	
50,000	.0155	....	
52,000	.0196	....	
54,000	.0241	....	
56,000	.0279	....	
58,000	.0330	....	
60,000	.0371	....	
64,000	.0489	....	
68,000	.0590	....	
72,000	.0705	....	
76,000	.0846	....	
80,000	.1015	....	
84,000	.1221	....	
88,000	.1471	....	
92,000	.20	....	
96,000	.26	....	
96,800	.31 .51	....	Tensile strength.
0	.58	....	= 19.3 per cent.

Elongation of inch sections, ".15, ".15, ".28*.

Diameter at fracture, ".45; area, .1590 square inch.

Contraction of area, 36.4 per cent.

Appearance of fracture, granular, 60 per cent; silky center, 40 per cent.

Maximum load sustained while specimen elongated from ".31 to ".51.

No. 8049.

Heated high forging heat (expansion, ″.232 in 12″.504) and drawn down under the hammer. Reduction, 60.6 per cent.

Reheated to initial forging temperature and cooled in sand.

Marks, 19***.

Diameter, ″.564.

Sectional area, .25 square inch.

Gauged length. 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
30,000	.0028	0.	
40,000	.0038	0.	
45,000	.0043	....	
48,000	.0047	....	Elastic limit.
49,000	.0064	....	
50,000	.0119	....	
51,000	.0132	....	
52,000	.0155	....	
53,000	.0175	....	
54,000	.0193	....	
56,000	.0231	....	
58,000	.0277	....	
60,000	.0316	....	
64,000	.0409	....	
68,000	.0505	....	
72,000	.0610	....	
76,000	.0735	....	
80,000	.0870	....	
84,000	.1031	....	
88,000	.1240	....	
92,000	.15	....	
96,000	.19	....	
98,000	.22	....	
100,000	.26	....	
101,360	.37	....	Tensile strength.
0	.54	....	=18 per cent.

Elongation of inch sections, ″.12, ″.24*, ″.18.

Diameter at fracture, ″.45; area, .1590 square inch.

Contraction of area, 36.4 per cent.

Appearance of fracture, granular, 50 per cent; silky center, 50 per cent.

TABULATION OF TENSILE SPECIMENS FROM 62-INCH CARBON STEEL INGOT.

Forged specimens, square bars drawn down under the hammer at different temperatures, cooled in sand, subsequently reheated and finally cooled in sand.

Specimens ".564 diameter by 3" length of stem.

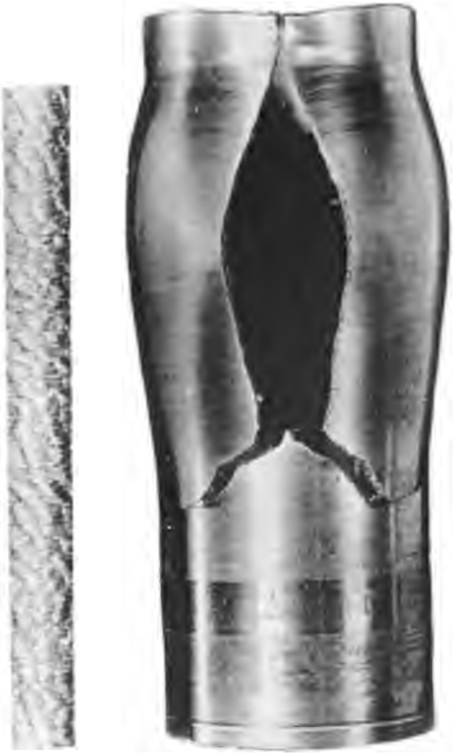
No. of test.	Marks.	Forging heat.	Reheated to—	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	
8015	1*	Low forging	Not reheated	57,500	99,840	21.3	41.9	Fine, silky.
8016	1**	do	Blood red	56,000	96,000	21.3	47.2	Do.
8017	1***	do	Low cherry	56,000	94,000	25.0	44.6	Do.
8018	2*	do	Full cherry	52,000	95,000	19.0	49.7	Do.
8019	2**	do	Low yellow	57,000	92,400	22.3	47.2	Do.
8020	2****	do	Bright yellow	51,800	95,000	22.0	44.6	Do.
8021	3	do	White heat	44,000	103,120	15.3	30.6	Granular; silky center.
8022	6*	High forging	Not reheated	55,000	106,000	18.3	39.2	Silky, in part granular.
8023	6**	do	Blood red	54,000	106,080	17.0	33.5	Granular; silky spot at circumference.
8024	6***	do	Low cherry	54,000	106,400	17.7	33.5	Do.
8025	7*	do	Full cherry	50,000	92,000	23.3	52.2	Fine, silky.
8025	7**	do	Low yellow	62,400	96,400	21.0	30.6	Do.
8027	7***	do	Bright yellow	53,000	96,000	21.3	44.6	Do.
8028	8*	do	White heat	44,000	97,200	16.3	33.5	Granular; silky center.
8029	11*	Low forging		48,000	98,560	20.7	41.9	Silky.
8030	11**	do	Blood red	48,000	95,760	20.3	44.6	Do.
8031	11***	do	Low cherry	48,000	94,120	23.3	44.6	Do.
8032	12*	do	Full cherry	46,000	97,208	22.0	44.6	Do.
8033	12**	do	Low yellow	56,200	92,480	25.0	49.7	Do.
8034	12***	do	Full yellow	51,000	93,360	20.3	44.6	Fine, silky.
8035	16*	High forging		50,000	107,200	15.3	36.4	Granular; silky center.
8036	16**	do	Blood red	52,000	106,400	17.3	33.5	Granular, 60 per cent; silky, 40 per cent.
8037	16***	do	Low cherry	50,000	105,200	16.3	27.6	Granular; silky spot at circumference.
8038	17*	do	Full cherry	40,000	89,680	18.3	44.6	Granular, 50 per cent; silky, 50 per cent.
8039	17**	do	Low yellow	57,000	92,000	23.7	47.2	Fine, silky.
8040	17***	do	Bright yellow	55,200	91,520	23.7	47.2	Do.
8042	3**	Low forging	Not reheated	53,000	94,560	20.3	41.9	Do.
8043	4****	do	do	56,800	94,000	24.3	47.2	Do.

TABULATION OF TENSILE SPECIMENS FROM 62-INCH CARBON STEEL INGOT—Continued.

No. of test.	Marks.	Forging heat.	Reheated to—	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	
8044	8^{**}	High forging	Not reheated	50,200	95,200	20.0	44.6	Silky, and granular.
8045	9^{****}	do	do	49,000	94,000	20.0	47.2	Fine, silky.
8046	13^{**}	Low forging		47,000	97,200	20.0	44.6	Do.
8047	14^{***}	do		45,000	94,960	19.7	39.2	Do.
8048	17^{****}	High forging		44,000	96,800	19.3	36.4	Granular, 60 per cent; silky center, 40 per cent.
8049	19^{***}	do		48,000	101,360	18.0	36.4	Granular, 50 per cent; silky center, 50 per cent.

Specimens numbers 8029 to 8040, inclusive, and numbers 8046 to 8049, inclusive, were reheated immediately after forging to the original forging temperatures and then cooled in sand. Numbers 8030 to 8034 and 8036 to 8040, inclusive, were again heated as shown above and finally cooled in sand.

SHRAPNEL CASES.



3 INCH SHRAPNEL CASE.

PHOTOGRAPH OF CASE NO. 1, AFTER RUPTURE, AND STRIP FOR BENDING TEST.

HELIOTYPE CO., BOSTON.

Shrapnel cases received from Frankford Arsenal.
Cases made by the Bethlehem Steel Company.
Two finished cases and one rough-turned case.

FIRST CASE.

TEST BY INTERIOR HYDROSTATIC PRESSURE.

Exterior diameter of case turned to 2″.92.

Interior diameter of case bored to 2″.715 for a length of 5″.

Case entered testing cylinder 1″, leaving 4″ length of reduced thickness of walls exposed to the interior pressures of the test.

Sectional area of piston, 5.79 square inches.

Applied loads.			Exterior diameter of case.	Remarks.
Total on piston.	Interior pressure per square inch.	Fiber stress on case per square inch.		
Pounds	*Pounds.*	*Pounds.*	*Inches.*	
0	0	0	2.92	
24,000	4,145	58,424	2.94	
30,000	5,181	....	2.95	
35,000	6,045	....	2.97	
40,000	6,908	....	2.99	
43,000	7,426	....	3.00	
46,000	7,945	111,986	3.04	Rapid expansion.
50,000	8,636	....	3.07	
52,600	9,085	128,054	....	Ultimate strength.

Case ruptured longitudinally, beginning at a point in the exterior surface near the middle of the length of the section of reduced thickness. The line of rupture extended in one direction to the end of the case; in the opposite direction to the end of the reduced part, where the line of fracture bifurcated, curving to circumferential directions.

Appearance of fracture, granular.

Length of circumference after rupture, maximum, 10″.40.

Circumferential extension, 1″.23 = 13.4 per cent.

SECOND CASE.

LONGITUDINAL COMPRESSION TEST.

Threaded section at forward end cut off.
Sectional area, minimum, 1.376 square inches.
Gauged length, established forward the band, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,376	1,000	0.	0.	Initial load.
6,880	5,000	.0005	....	
13,760	10,000	.0010	....	
20,640	15,000	.0017	....	
27,520	20,000	.0023	0.	
34,400	25,000	.0030	....	
41,280	30,000	.0036	....	
48,160	35,000	.0042	....	
55,040	40,000	.0049	.0001	
61,920	45,000	.0055	....	
68,800	50,000	.0061	....	
75,680	55,000	.0068	....	
82,560	60,000	.0074	.0001	
89,440	65,000	.0093	.0012	
96,320	70,000	.0131	.0040	
103,200	75,000	.0186	.0084	
110,080	80,000	.0247	.0135	
116,960	85,000	.0323	.0200	
123,840	90,000	.0409	.0275	
171,500	124,640	....	....	Ultimate strength.

The case buckled near the forward end, near the place of minimum sectional area. The buckling was continued, under diminished loads after attaining the maximum, until the length of the case was shortened to 7".72 over all. Two longitudinal cracks now opened, nearly opposite diametrically.

Appearance of fracture, granular.

Length of circumference over the maximum diameter of the buckled part, 10".70.

Circumferential extension, 1".34 = 14.3 per cent.

THIRD CASE.

Longitudinal tensile specimens, unannealed and annealed, from rough-turned case.

Description.	Dimensions.		Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 8 inches.		Area at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Width.	Thickness.									
	Inch.	*Inch.*	*Sq. inch.*	*Pounds.*	*Pounds.*	*Inch.*	*Per cent.*	*Sq. inch.*	*Per cent.*	" " "	
Unannealed	.501	.119	.060	63,330	127,000	.36	12.0	.044	26.7	.07, .15*, .14*	Silky, 40 per cent; granular, 60 per cent.
Do	.501	.121	.061	55,740	123,610	.34	11.3	.045	26.2	.07, .09, .18*	Silky, 10 per cent; granular, 90 per cent.
Annealed	.501	.125	.063	65,080	124,440	.34	11.3	.043	31.7	.06, .10, .18*	Silky, 20 per cent; granular, 80 per cent.
Do	.501	.123	.062	70,320	129,350	.37	12.3	.043	30.6	.06, .12, .19*	Silky; oblique.

BENDING TEST.

Strip ¾" wide by the thickness of the case, shown in photograph with ruptured case No. 1, was bent cold. The strip bent 110 degrees over a radius of curvature of ¾" before rupture, the bending quality being substantially the same whether the outside, rough-turned surface or the inside surface of the case was on the tension side of the bend.

CHEMICAL ANALYSIS.

Carbon	.55
Manganese	.69
Silicon	.276
Sulphur	.030
Phosphorus	.025

RAILROAD MATERIAL.

Track observations on Boston and Albany Railroad at Faneuil Station, Boston, Mass.

Resistance of nuts on bolts of splice bars, as found in the track, against further tightening.

Tests were made with a wrench 33 inches long, the resistance against tightening being shown by the force required at the end of the wrench to turn the nuts forward.

No. of track.	Rail.	No. of bolt in joint.	Resistance.	No. of track.	Rail.	No. of bolt in joint.	Resistance.
			Pounds.				*Pounds.*
2	....	1	25	1	RH	1	92
2	....	2	34	1	RH	2	58
2	....	3	55	1	RH	3	74
2	....	4	75	1	RH	4	65
1	LH	1	4	1	LH	1	98
1	LH	2	23	1	LH	2	70
1	LH	3	26	1	LH	3	75
1	LH	4	70	1	LH	4	67
1	RH	1	80	1	RH	1	45
1	RH	2	45	1	RH	2	47
1	RH	3	62	1	RH	3	40
1	RH	4	24	1	RH	4	64
1	LH	1	44	3	LH	1	68
1	LH	2	48	3	LH	2	45
1	LH	3	47	3	LH	3	51
1	LH	4	60	3	LH	4	72
1	RH	1	59	3	RH	1	95
1	RH	2	24	3	RH	2	65
1	RH	3	33	3	RH	3	68
1	RH	4	24	3	RH	4	68
1	LH	1	15	3	LH	1	65
1	LH	2	34	3	LH	2	53
1	LH	3	Loose.	3	LH	3	52
1	LH	4	Do.	3	LH	4	90
1	RH	1	51	3	RH	1	70
1	RH	2	40	3	RH	2	51
1	RH	3	47	3	RH	3	37
1	RH	4	21	3	RH	4	45
1	LH	1	56				
1	LH	2	67				
1	LH	3	35				
1	LH	4	70				

Average of 60 observations, 52 pounds, on 33-inch wrench.

Rail on track 1 branded: "L. I. & S. Co., S. W. Scranton, 12-93, B. & A., 95 D., Pat. 1892."

Rail on track 3 branded: "L. I. & S. Co., S. W. Scranton, 5-97, B. & A., 95 D., Recd. 1891, Pat. 1892."

FRICTIONAL RESISTANCE OF RAIL JOINT.

Test on the frictional resistance of two six-hole splice bars on two sections of 100-pound rail.

Rails 6″ high.

Rail ends marked 68 and 69.

Splice bars marked 87 and 88.

Spring nut locks were used under nuts; ¾″ bolts, 10 threads per inch.

Length of wrench, 33″.

Tightening force applied to wrench.	Frictional resistance of joint.	
	Initial.	Continuous movement.
Pounds.	*Pounds.*	*Pounds.*
50	37,500	33,800
75	46,900	44,700
5 bolts at 85 1 bolt at 110	72,800	65,500
50	31,000	28,600

The maximum pull applied to five of the bolts in the third test, 85 pounds on a 33-inch wrench, was the limit of strength of the bolts. This pull on the wrench caused a permanent elongation of about ".06 to ".10 on each of the five bolts. The sixth bolt resisted a pull of 110 pounds on the wrench without material elongation.

After making observations on the frictional resistance in these tests, the first test, with bolts tightened with 50 pounds' pull, was repeated.

After completing the tests as above the nut on one bolt was set up until the bolt was fractured. Rupture occurred in the body of the bolt ½" from the end of the threaded section. The metal drew down at the place of rupture to ".48 diameter. Appearance of fracture, silky. The pull on the wrench while rupture was in progress did not exceed 85 pounds.

The splice bars were now used on one piece of rail, using four bolts, the nuts of which were tightened with a pull of 50 pounds on a 33-inch wrench. Initial resistance, 50,900 pounds. Movement continued under 31,200 pounds.

Test with four bolts in one piece of rail, with 50 pounds' pull on wrench, repeated. Initial resistance, 59,200 pounds. Movement continued under 41,600 pounds.

The tension on the bolts was reduced during the test, and after the last observations were made the nuts could be further tightened with a pull of 30 pounds. Each nut could be turned up 90 degrees before again attaining a resistance of 50 pounds on the wrench.

One-half joint again made up with 4 bolts and 50 pounds' pull on the wrench. Initial resistance, 66,500 pounds. The slipping of the angle bars occurred with a series of throbs, immediately followed in each instance by a reduction in the load on the bars. The succeeding throbs took place under gradually diminishing loads, falling to 49,300 pounds at the fourth throb. When removed from the testing machine, the nuts could be turned on with an average pull of 35 pounds on the wrench.

SPLICE-BAR METAL FOR 80-POUND RAILROAD RAILS.

SPECIMENS FROM SPLICE BARS FOR 5⅛" 80-POUND RAIL.

NICKEL STEEL.

No. 7970.

Marks, 84, N–1.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
20,000	.0018	....	
30,000	.0027	0.	
35,000	.0032	....	
40,000	.0037	0.	
50,000	.0048	....	
52,000	.0052	....	
53,000	.0053	....	Elastic limit.
54,000	.0060 .0757	....	
56,000	.09	....	
58,000	.10	....	
60,000	.12	....	
65,000	.19	....	
70,000	.32	....	
73,200	....	....	Tensile strength.
0	.91	....	=30.3 per cent.

Elongation of inch sections, ".20, ".50*, ".21.
Diameter at fracture, ".37; area, .1075 square inch.
Contraction of area, 57 per cent.
Fractured at the middle of the stem.
Appearance of fracture, fine silky.

NICKEL STEEL.

No. 7971.

Marks, 84, N–2.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
20,000	.0017	....	
30,000	.0029	0.	
35,000	.0034	....	
40,000	.0040	....	
50,000	.0057	.0006	Elastic limit.
51,000	.0062	....	
52,000	.0559	....	
54,000	.08	....	
56,000	.09	....	
58,000	.10	....	
60,000	.12	....	
64,000	.18	....	
68,000	.25	....	
72,000	.40	....	
72,800	....	....	Tensile strength.
0	.91	....	=30.3 per cent.

Elongation of inch sections, ″.24, ″.49*, ″.18.
Diameter at fracture, ″.36; area, .1018 square inch.
Contraction of area, 59.3 per cent.
Fractured 1″.7 from the neck.
Appearance of fracture, fine silky.

NICKEL STEEL.

No. 7972.

Marks, 84, N-3.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	....	
20,000	.0017	....	
30,000	.0029	0.	
35,000	.0034	....	
40,000	.0040	....	
50,000	.0053	.0002	Elastic limit.
51,000	.0055	....	
52,000	.0057	....	
53,000	.0600	....	
54,000	.08	....	
56,000	.09	....	
58,000	.10	....	
60,000	.12	....	
64,000	.16	....	
68,000	.25	....	
72,000	.41	....	
72,800	....	....	Tensile strength.
0	.91	....	=30.5 per cent.

Elongation of inch sections, ".20, ".51*, ".20.
Diameter at fracture, ".36; area, .1018 square inch.
Contraction of area, 59.3 per cent.
Fractured 1".71 from the neck.
Appearance of fracture, fine silky.

CARBON STEEL.

No. 7973.

Marks, 85–1.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	....	
20,000	.0017	....	
30,000	.0028	0.	
32,000	.0030	....	Elastic limit.
30,400	.0116	....	
31,000	.0200	....	
32,000	.0560	....	
34,000	.07	....	
36,000	.08	....	
38,000	.09	....	
40,000	.10	....	
44,000	.15	....	
48,000	.21	....	
52,000	.30	....	
56,000	.60	....	Tensile strength.
0	1.10	....	=36.7 per cent.

Elongation of inch sections, ″.23, ″.62*, ″.25.
Diameter at fracture, ″.33; area, .0855 square inch.
Contraction of area, 65.8 per cent.
Fractured at the middle of the stem.
Appearance of fracture, fine silky.

CARBON STEEL.

No. 7974.

Marks, 85-2.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	....	
20,000	.0018	....	
30,000	.0028	0.	
31,000	.0029	....	
32,000	.0030	....	Elastic limit.
33,000	.0646	....	
34,000	.07	....	
36,000	.08	....	
38,000	.09	....	
40,000	.11	....	
44,000	.15	....	
48,000	.20	....	
52,000	.31	....	
56,000	.59	....	Tensile strength.
0	1.12	....	=37.3 per cent.

Elongation of inch sections, ″.25, ″.61*, ″.26.
Diameter at fracture, ″.33; area, .0855 square inch.
Contraction of area, 65.8 per cent.
Fractured at the middle of the stem.
Appearance of fracture, fine silky.

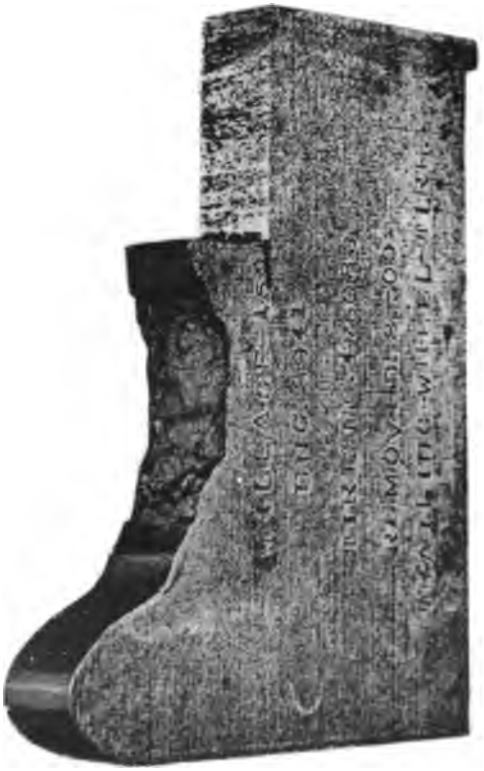
CARBON STEEL.

No. 7975.

Marks, 85-3.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	....	
20,000	.0018	....	
30,000	.0029	0.	
31,000	.0030	....	
32,000	.0031	....	Elastic limit.
33,000	.0612	....	
35,000	.07	....	
36,000	.08	....	
38,000	.09	....	
40,000	.11	....	
44,000	.15	....	
48,000	.20	....	
52,000	.30	....	
56,000	.53	....	
56,400	....	....	Tensile strength.
0	1.11	....	=37 per cent.

Elongation of inch sections, ″.26, ″.61*, ″.24.
Diameter at fracture, ″.32; area, .0804 square inch.
Contraction of area, 67.8 per cent.
Fractured 1″.85 from the neck.
Appearance of fracture, fine silky.



LOCOMOTIVE TRAILING WHEEL TIRE NO. 475,083, SEGMENT SHOWING WHERE A PIECE OF METAL WAS DETACHED FROM THE TREAD, WHILE THE TIRE WAS IN SERVICE. A RECTANGULAR PIECE SUBSEQUENTLY SAWED OUT OF CORNER OF SEGMENT.

HELIOTYPE CO., BOSTON.

STEEL SPECIMENS FROM LOCOMOTIVE TRAILING WHEEL TIRE, NO. 475083.

No. 7860.

Specimen from middle of thickness of tread.
Marks, 3A.
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	....	
20,000	.0013	....	
30,000	.0020	....	
40,000	.0026	0.	
50,000	.0035	....	
51,000	.0037	....	
52,000	.0039	....	Elastic limit.
53,000	.0042	....	
54,000	.0045	....	
55,000	.0050	.0011	
56,000	.0057	....	
57,000	.0061	....	
58,000	.0068	....	
59,000	.0079	....	
60,000	.0088	.0043	
62,000	.0104	....	
64,000	.0122	....	
66,000	.0144	....	
68,000	.0168	....	
70,000	.0188	.0130	
72,000	.0209	....	
76,000	.0255	....	
80,000	.0313	.0240	
88,000	.04	....	
96,000	.06	....	
104,000	.08	....	
112,000	.11	....	
114,500	....	....	Tensile strength.
0	.15	....	=7.5 per cent.

Elongation of inch sections, ".09*, ".06*.
Diameter at fracture, ".48; area, .1810 square inch.
Contraction of area, 9.5 per cent.
Fractured at the middle of the stem.
Appearance of fracture, medium granular.

No. 7861.

Radial specimen from flange side of tire.
Marks, 1A.
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	....	
20,000	.0013	....	
30,000	.0020	....	
40,000	.0027	0.	
50,000	.0035	0.	
54,000	.0038	....	Elastic limit.
55,000	.0041	....	
56,000	.0045	....	
57,000	.0050	....	
58,000	.0056	....	
59,000	.0062	....	
60,000	.0068	.0024	
62,000	.0087	....	
64,000	.0103	....	
66,000	.0123	....	
68,000	.0145	....	
70,000	.0165	.0107	
72,000	.0186	....	
76,000	.0230	....	
80,000	.0285	.0214	
88,000	.04	....	
96,000	.05	....	
104,000	.07	....	
112,000	.10	....	
117,400	....	....	Tensile strength.
0	.13	....	=6.5 per cent.

Elongation of inch sections, ".04, ".09*.
Diameter at fracture, ".48; area, .1810 square inch.
Contraction of area, 9.5 per cent.
Fractured ".2 from the neck.
Appearance of fracture, medium granular.

No. 7862.

Marks, 2.
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	....	
20,000	.0013	....	
30,000	.0019	....	
40,000	.0025	0.	
50,000	.0033	0.	
57,000	.0039	....	
58,000	.0041	....	
59,000	.0043	....	Elastic limit.
60,000	.0047	.0005	
61,000	.0052	....	
62,000	.0057	....	
63,000	.0061	....	
64,000	.0067	....	
65,000	.0072	.0025	
66,000	.0081	....	
68,000	.0095	....	
70,000	.0116	.0062	
72,000	.0136	....	
76,000	.0184	....	
80,000	.0239	.0169	
88,000	.03	....	
96,000	.05	....	
104,000	.07	....	
112,000	.09	....	
120,000	.15	....	
121,500	....	....	Tensile strength.
0	.16	....	=8 per cent.

Elongation of inch sections, ".10*, ".06.
Diameter at fracture, ".48; area, .1810 square inch.
Contraction of area, 9.5 per cent.
Fractured ".4 from the neck.
Appearance of fracture, granular.

No. 7863.

Marks, 4.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005	....	
20,000	.0012	....	
30,000	.0019	....	
40,000	.0025	0.	
50,000	.0033	0.	
53,000	.0036	....	Elastic limit.
54,000	.0040	....	
55,000	.0045	....	
56,000	.0053	....	
57,000	.0060	....	
58,000	.0071	....	
59,000	.0081	....	
60,000	.0092	.0046	
62,000	.0111	....	
64,000	.0132	....	
66,000	.0151	....	
68,000	.0175	....	
70,000	.0196	.0139	
72,000	.0220	....	
76,000	.0270	....	
80,000	.0327	.0255	
88,000	.04	....	
96,000	.06	....	
104,000	.08	....	
112,000	.11	....	
116,400	....	....	Tensile strength.
0	.16	....	=8 per cent.

Elongation of inch sections, ″.07*, ″.09*.
Diameter at fracture, ″.48; area, .1810 square inch.
Contraction of area, 9.5 per cent.
Fractured at the middle of the stem.
Appearance of fracture, granular.

STEEL RAILS.

CHEMICAL ANALYSES.

Description.	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
Old 85-pound Cambria rail from Boston Elevated Railway	.460	1.100	.070	.023	.095
"235 Maryland 111111′ 02′" from Mr. P. H. Dudley	.440	....	.040	.063	.050

RETESTS OF DOUBLE-REFINED WROUGHT IRON.

SPECIMENS FROM FRACTURED END OF DOUBLE-REFINED IRON BAR S-220.

For previous test see Report 1882, page 192.

Retested after an interval of rest of 22 years.

Original diameter of bar, 2″.01.

Average diameter of bar after the original test, 1″.82.

Tensile stress per square inch on average sectional area of bar at time of original test, 61,200 pounds.

No. 7942.

Marks, S-220.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	....	
20,000	.0019	....	
30,000	.0030	0.	
40,000	.0043	....	
45,000	.0048	....	
50,000	.0054	0.	
55,000	.0060	....	
60,000	.0066	.0001	
61,000	.0067	....	
62,000	.0069	....	
63,000	.0071	....	
64,000	.0073	....	
65,000	.0074	.0001	
66,000	.0075	....	
67,000	.0078	....	
68,000	.0085	....	
69,000	.0920	....	
69,400	....	....	Tensile strength.
0	.26	....	=8.7 per cent.

Load on bar at time of rupture, 12,100 pounds = 83,330 pounds per square inch on area at fracture.

Elongation of inch sections, ″.04, ″.18*, ″.04.

Diameter at fracture, ″.43; area, .1452 square inch.

Contraction of area, 27.4 per cent.

Fractured at the middle of the stem.

Appearance of fracture, fibrous.

No. 7943.

Marks, S–220.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	....	
20,000	.0022	....	
30,000	.0033	....	
40,000	.0044	....	
50,000	.0055	0.	
55,000	.0061	....	
60,000	.0068	0.	
61,000	.0070	....	
62,000	.0071	....	
63,000	.0073	....	
64,000	.0074	....	
65,000	.0075	0.	
66,000	.0076	....	
67,000	.0077	....	
68,000	.0080	....	
69,000	.0084	....	
70,000	.0518	....	
71,300	....	....	Tensile strength.
0	.29	....	−9.7 per cent.

Load on bar at time of rupture, 12,400 pounds = 89,530 pounds per square inch on area at fracture.

Elongation of inch sections, ″.13*, ″.13*, ″.03.

Diameter at fracture, ″.42; area, .1385 square inch.

Contraction of area, 30.7 per cent.

Fractured 1″.13 from the neck.

Appearance of fracture, fibrous.

STEEL WIRE.

TENSILE TESTS OF STEEL WIRE RECEIVED FROM SPRINGFIELD ARMORY.

Specimen tagged: "Wire for Main Spring, U. S. Magazine Rifle, Model 1903. Best steel wire, tempered. Music."

Diameter, ".047.

Sectional area, .001735 square inch.

Gauged length, 6".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
40	....	0.	0.	Initial load.
100	....	.0074	....	
200	....	.0190	0.	
300	....	.0312	.0006	
320	....	.0345	....	
340	....	.0366	....	
360	....	.0391	....	
380	....	.0416	....	
400	....	.0442	.0018	
420	....	.0460	....	
440	....	.0484	....	
460	....	.0510	....	
480	....	.0534	....	
500	....	.0564	.0036	
520	....	.0606	....	
540	....	.0642	....	
560	....	.0677	....	
580	....	.0715	....	
652	375,790	....	....	Tensile strength.

Fractured at middle of length.

Diameter at fracture, ".037; area, .001075 square inch.

Contraction of area, 38 per cent.

Appearance of fracture, silky.

Specimen tagged: "Wire for Sear Spring, U. S. Magazine Rifle, Model 1903. Wire, steel, tempered, music, best quality."
Diameter, ".041.
Sectional area, .00132 square inch.
Gauged length, 6".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
40	....	0.	0.	Initial load.
100	....	.0092	....	
200	....	.0250	0.	
300	....	.0411	.0021	
320	....	.0448	....	
340	....	.0480	....	
360	....	.0516	....	
380	....	.0554	....	
400	....	.0602	.0054	
420	....	.0654	....	
440	....	.0701	....	
460	....	.0762	....	
512	387,880	....	....	Tensile strength.

Fractured 1¾" from the jaws.
Diameter at fracture, ".032; area, .00080 square inch.
Contraction of area, 39.4 per cent.
Appearance of fracture, silky, cup-shaped.

Specimen tagged: "Sample music wire, steel, ″.048, used for main springs, U. S. rifle, Model 1903."

Diameter, ″.048.

Sectional area, .00181 square inch.

Gauged length, 6″.

Radius of curvature of coil, wire in natural state, 8″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
40	....	0.	0.	Initial load.
100	....	.0070	....	
200	....	.0185	—.0005	
300	....	.0305	0.	
320	....	.0328	....	
340	....	.0351	....	
360	....	.0377	....	
380	....	.0403	....	
400	....	.0429	.0007	
420	....	.0450	....	
440	....	.0477	....	
460	....	.0504	....	
480	....	.0535	....	
500	....	.0562	.0028	
520	....	.0600	....	
540	....	.0645	....	
560	....	.0700	....	
580	....	.0756	....	
655	361,880	....	....	Tensile strength.

Fractured 2¼″ from face of jaws.

Diameter at fracture, ″.036; area, .00102 square inch.

Contraction of area, 43.6 per cent.

Appearance of fracture, silky.

Specimen tagged: "Sample music wire, steel, ″.041, used for sear springs, U. S. Magazine Rifle, Model 1903."
Diameter, ″.041.
Sectional area, .00132 square inch.
Gauged length, 6″.
Radius of curvature of coil, wire in natural state, 6¼″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
40	....	0.	0.	Initial load.
100	....	.0096	....	
200	....	.0259	−.0002	
300	....	.0471	.0051	
320	....	.0516	....	
340	....	.0547	....	
360	....	.0592	....	
380	....	.0650	....	
400	....	.0716	.0130	
420	....	.0820	....	
452	342,420	....	....	Tensile strength.

Fractured at face of jaws.
Diameter at fracture, ″.030; area, .00071 square inch.
Contraction of area, 46.2 per cent.
Appearance of fracture, silky.

CORDAGE.

TENSILE TESTS OF MANILA AND HEMP ROPE FOR THE U. S. LIGHT-HOUSE ESTABISHMENT, THIRD DISTRICT, TOMPKINSVILLE, N. Y.

Samples prepared with eye splices at the ends.
Length between splices, 3 to 6 feet.

Marks.	Tensile strength.	Parted.
	Pounds.	
1½" manila, 3 strands	2,240	1 strand at the splice.
Do	2,280	1 strand at middle.
Do	2,220	1 strand at the splice.
2" manila, 4 strands	4,710	2 strands at the splice.
Do	4,490	1 strand at the splice.
Do	5,150	2 strands at the splice.
2½" manila, 4 strands	7,100	1 strand at the splice.
Do	7,050	2 strands at the splice.
Do	6,980	2 strands 30" from splice.
3" manila, 4 strands	8,700	1 strand at the splice.
Do	8,780	Do.
Do	8,600	Do.
3" hemp, 4 strands	5,100	1 strand 10" from splice.
3½" manila, 4 strands	12,600	2 strands at the splice.
Do	11,400	1 strand at the splice.
Do	11,400	2 strands at the splice.
4" manila, 4 strands	12,900	1 strand at the splice.
Do	12,900	2 strands at the splice..
Do	14,200	2 strands 12" from splice.
5" manila, 4 strands	21,200	2 strands at the splice.
Do	19,900	Do.
7" manila, 4 strands	38,100	1 strand at the splice.

Hemp Rope.

Size.	Actual circumference.	Tensile strength.	Parted.
Inches.	*Inches.*	*Pounds.*	
3	3.6	5,320	1 strand at the splice.
3	3.6	5,410	Do.
3	3.6	4,740	Do.

CARTRIDGE BELT.

WOVEN COTTON BELT, WITH POCKETS.

TEST OF A WOVEN CARTRIDGE BELT FOR THE ORDNANCE DEPARTMENT, U. S. ARMY.

Belt tagged "Sample A," from Russell Manufacturing Company, Middletown, Conn.

Belt carries nine pockets.

First pocket.—Tested by pulling against lower corner, close to the stitching, using an iron hook ⅝″ wide, ⅛″ thick, with rounded corners. Strength, 84 pounds. Tore the stitching.

The strength of the opposite corner was found to be 112 pounds. Stitching tore.

After both corners had been tested as above the strength of the stitching at the lower edge of the pocket was determined by means of a hook 1⅞″ wide by 5/16″ thick, with rounded edge, which rested against the bottom of the pocket. Strength, 213 pounds. Stitching tore across lower edge of pocket.

Second pocket.—Tested by pulling against the bottom of the pocket by means of the hook last described. Reaction of the pull taken by the flap. Strength, 204 pounds. Pulled off the flap. Stitching across bottom of pocket ripped 1¼″ in length.

Third pocket.—Tested in the same manner as second pocket. Strength, 156 pounds. Pulled off the flap and ripped stitching across bottom 1⅛″ in length.

Fourth pocket.—Tested in the same manner as the second pocket. Strength, 208 pounds. Pulled off flap and ripped stitching across bottom of pocket.

Fifth pocket.—Direct pull on stitching across lower edge of pocket. Sides of pocket were split open and front turned down. Strength, 154 pounds. Ripped the stitching and tore webbing at lower edge of pocket.

Sixth pocket.—Tested in the same manner as the fifth pocket. Strength, 156 pounds. Ripped the stitching and tore the webbing.

Seventh pocket.—Tested in the same manner as the fifth pocket. Strength, 154 pounds. Ripped the stitching.

Eighth pocket.—Tested by pulling against the upper corner of the pocket by means of an iron hook ⅝″ diameter, with end bent at a right angle with stem. Strength, 434 pounds. Tore the webbing at both upper corners of pocket.

Ninth pocket.—Tested in the same manner as the eighth pocket. Strength, 380 pounds. The iron hook punched a hole through the pocket and tore out.

ENDURANCE OF ROTATING SHAFTS.

No. 375.

Marks, .17C.
Gautier steel bar; 0.17 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
30,000	0	0	a	.1553	.1310	.1552	.0242	.0001	
			b	.1556	.1312	.1555	.0243	.0001	
	1,000	1,000	a	.1553	.1310	.1552	.0242	.0001	
			b	.1557	.1312	.1555	.0243	.0002	
	9,000	10,000	a	.1553	.1308	.1553	.0245	0.	
			b	.1557	.1312	.1555	.0243	.0002	
	90,000	100,000	a	.1553	.1309	.1552	.0243	.0001	
			b	.1557	.1309	.1555	.0246	.0002	
	65,560,780	65,660,780							Bar not ruptured.

No. 383.

Marks, .55C.
Gautier steel bar; 0.55 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
30,000	0	0	a	.1545	.1302	.1544	.0242	.0001	
			b	.1545	.1304	.1544	.0240	.0001	
	1,000	1,000	a	.1543	.1301	.1543	.0242	0.	
			b	.1545	.1300	.1544	.0244	.0001	
	9,000	10,000	a	.1543	.1301	.1543	.0242	0.	
			b	.1544	.1300	.1543	.0243	.0001	
	90,000	100,000	a	.1544	.1300	.1543	.0243	.0001	
			b	.1544	.1300	.1543	.0243	.0001	
	60,746,970	60,846,970							Bar not ruptured.

ENDURANCE OF ROTATING SHAFTS.

SUMMARIZED TABULATION.

Speed of rotation, 500 per minute.

No. of test.	Marks.	Material.	Treatment.	Composition.				Maximum fiber stress per square inch.	Number of rotations.		Remarks.
				C.	Mn.	Si.	Ni.		Successive.	Total.	
								Pounds.			
375	.17C	Gautier steel.....	Hot rolled bar....	.17	.57	.04	......	30,000	65,660,780	65,660,780	Bar not ruptured.
383	.55C	.....do...........	.....do...........	.55	.75	.14	......	30,000	60,846,970	60,846,970	Do.
385	.82C	.....do...........	.....do...........	.82	.36	.10	......	35,000	61,200,150	61,200,150	Do.
386	.82C	.....do...........	.....do...........	.82	.36	.10	......	50,000	213,150	213,150	Bar ruptured in south middle bearing. Mechanical work at rupture=750,465 foot-pounds per cubic inch.
387	.82C	.....do...........	.....do...........	.82	.36	.10	......	45,000	605,460	605,460	Bar ruptured about midway between middle bearings. Mechanical work at rupture=1,736,910 foot-pounds per cubic inch.
388	.82C	.....do...........	.....do...........	.82	.36	.10	......	40,000	58,140,720	58,140,720	Bar not ruptured.

METAL FROM ENDURANCE TESTS OF ROTATING SHAFTS.

TENSILE SPECIMENS REPRESENTING METAL OF ENDURANCE SHAFTS.

The marks give the test numbers of the endurance shaft and other figures or letters for identification.

No. 7940.

Barrow steel, 1873.
Marks, 346; Rail 43.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test, see Report of 1903, page 324.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0008	....	
20,000	.0018	....	
30,000	.0029	....	
35,000	.0034	....	
40,000	.0039	0.	
45,000	.0045	....	
50,000	.0050	....	
54,000	.0056	....	Elastic limit.
55,000	.0059	.0004	
56,000	.0067	....	
57,000	.0110	....	
58,000	.0173	....	
59,000	.0184	....	
60,000	.0224	.0160	
62,000	.0268	....	
64,000	.0349	....	
68,000	.0485	....	
72,000	.0640	....	
76,000	.0830	....	
80,000	.1020	....	
84,000	.13	....	
88,000	.16	....	
92,000	.21	....	
96,000	.30	....	
97,200	....	....	Tensile strength.
0	.66	....	=22 per cent.

Elongation of inch sections, ″.14, ″.35*, ″.17.
Diameter at fracture, ″.42; area, .1385 square inch.
Contraction of area, 44.6 per cent.
Fractured 1″.47 from the neck.
Appearance of fracture, silky, interspersed with fine granulation.

AUXILIARY TO ENDURANCE TESTS.

Specimens to show mechanical work necessary to produce rupture.

No. 7937.

Marks, .17C.
Diameter, 1″.009.
Sectional area, .80 square inch.
Gauged length, 4″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0012	....	
20,000	.0026	....	
30,000	.0040	0.	
40,000	.0054	....	
45,000	.0062	....	
50,000	.0067	....	
51,000	.0069	....	Elastic limit. Load fell. Mechanical work at elastic limit, 43.7 inch-pounds =3.6 foot-pounds per cubic inch.
42,000	.0195	....	
43,000	.0277	....	
44,000	.0900	....	
46,000	.0992	....	
48,000	.1135	....	
50,000	.1293	....	
52,000	.1490	....	
54,000	.1700	.1610	
56,000	.19	....	
58,000	.22	....	
60,000	.25	....	
61,000	.28	....	
62,000	.30	....	
63,000	.34	....	
64,000	.38	....	
65,000	.42	....	
66,000	.48	....	
67,000	.57	....	
68,000	.78	....	Tensile strength.
0	1.34	....	=33.5 per cent. Mechanical work necessary to produce rupture, 11,783 inch-pounds =982 foot-pounds per cubic inch.

Load on bar at time of rupture, 45,700 pounds = 118,760 pounds per square inch on area at fracture.

Elongation of inch sections, ″.20, ″.55*, ″.38, ″.21.

Diameter at fracture, ″.70; area, .3848 square inch.

Contraction of area, 51.9 per cent.

Fractured 2″.46 from the neck.

Appearance of fracture, fine silky.

No. 7938.

Marks, .55C.
Diameter, 1".009.
Sectional area, .80 square inch.
Gauged length, 4".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0012	0.	
20,000	.0026	....	
30,000	.0041	0.	
40,000	.0055	....	
50,000	.0070	....	
55,000	.0078	....	
57,000	.0082	....	Elastic limit. Load fell. Mechanical work at elastic limit, 60 inch-pounds=5 foot-pounds per cubic inch.
54,000	.0125	....	
55,000	.0190	....	
56,000	.0329	....	
58,000	.0375	....	
60,000	.0421	....	
64,000	.0535	.0419	
68,000	.06	....	
72,000	.07	....	
76,000	.08	....	
80,000	.10	....	
84,000	.11	....	
88,000	.12	....	
92,000	.16	....	
96,000	.20	....	
100,000	.27	....	
104,000	.37	....	
106,100	.54	....	Tensile strength. Mechanical work necessary to produce rupture, 12,558 inch-pounds=1,047 foot-pounds per cubic inch.

Load on bar at time of rupture, 83,600 pounds = 128,540 pounds per square inch on area at fracture.

Diameter at fracture, ".91; area, .6504 square inch.

Contraction of area, 18.7 per cent.

Appearance of fracture, fine granular; silky spot at the center.

No. 7938a.

Supplementary test on material of bar marked .55C.
Diameter, ".798.
Sectional area, .50 square inch.
Gauged length, 4".
Elastic limit, 29,700 pounds = 59,400 pounds per square inch.
Tensile strength, 54,800 pounds = 109,600 pounds per square inch.
Elongation in 4 inches, ".65 = 16.2 per cent.
Diameter at fracture, ".71.
Contraction of area, 20.8 per cent.
Elongation of inch sections, ".13, ".21*, ".18, ".13.
Fractured 2".36 from the neck.
Appearance, fine granular; silky spot near the center.

No. 7944.

Marks, .82C.
Diameter, ″.714.
Sectional area, .40 square inch.
Gauged length, 4″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
10,000	.0013		
20,000	.0027		
30,000	.0041		
40,000	.0056		
50,000	.0070	0.	
60,000	.0084		
61,000	.0086		
62,000	.0088		
63,000	.0089	.0002	Elastic limit. Mechanical work at elastic limit. 70.7 inch-pounds=5.9 foot-pounds per cubic inch.
64,000	.0095		
65,000	.0130		
66,000	.0170		
68,000	.0201		
70,000	.0233		
72,000	.0256		
76,000	.0324		
80,000	.0386	.0040	
84,000	.0453		
88,000	.0525		
92,000	.0600		
96,000	.0680		
100,000	.0766	.0564	
104,000	.09		
108,000	.10		
112,000	.11		
116,000	.12		
120,000	.13		
124,000	.15		
128,000	.17		
132,000	.20		
136,000	.24		
140,000	.31		
142,250	.36		Tensile strength.
0	.34		=8.5 per cent. Mechanical work necessary to produce rupture, 10,652 inch-pounds=888 foot-pounds per cubic inch.

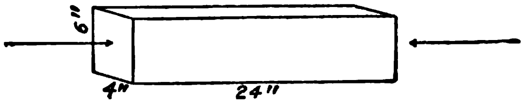
Elongation of inch sections, ″.09*, ″.09*, ″.08, ″.08.
Diameter at fracture, ″.69; area, .3739 square inch.
Contraction of area, 6.5 per cent.
Fractured 1″.35 from the neck.
Appearance of fracture, fine granular.
Fractured at center-punch mark defining inch sections.

CEMENT, MORTAR, AND CONCRETE PRISMS.

ELASTIC PROPERTIES AND COMPRESSIVE STRENGTH.

CEMENT, CEMENT MORTAR, AND CONCRETE PRISMS.

COMPRESSIVE ELASTIC PROPERTIES.



No. 1552.

Marks, Vul. June 19.

Composition: Vulcanite cement, neat.

Water used in gauging, 20 per cent of cement, by weight.

Age, set in water, 171 days. (First day and last 3 days in air.)

Weight per cubic foot (immediately after being taken from the water), 137.2 pounds.

Dimensions, 24".12 × 3".80 × 6".18.

Sectional area, 23.48 square inches.

Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,348	100	0.	0.	Initial load.
4,696	200	.0001	....	
7,044	300	.0002	....	
9,392	400	.0004	....	
11,740	500	.0006	0.	
14,088	600	.0009	....	
16,436	700	.0011	....	
18,784	800	.0013	....	
21,132	900	.0016	....	
23,480	1,000	.0019	.0001	E(500-1,000) = 5,000.000 pounds per square inch.
28,176	1,200	.0026	....	
32,872	1,400	.0034	....	
37,568	1,600	.0040	....	
42,264	1,800	.0046	....	
46,960	2,000	.0054	.0004	E(1,000-2,000) = 3 750,000 pounds per square inch.
51,656	2,200	.0061	....	
56,352	2,400	.0068	....	
61,048	2,600	.0075	....	
65,744	2,800	.0083	....	
70,440	3,000	.0090	.0009	E(2,000-3,000) = 3,870,000 pounds per square inch.
75,136	3,200	.0096	....	
79,832	3,400	.0103	....	
84,528	3,600	.0111	....	
89,224	3,800	.0118	....	
93,920	4,000	.0124	.0011	E(3,000-4,000) = 3,750,000 pounds per square inch.
98,616	4,200	.0130	....	
103,312	4,400	.0139	....	
108,008	4,600	.0146	....	
112,704	4,800	.0154	....	
117,400	5,000	.0162	.0015	E(4,000-5,000) = 3,529,000 pounds per square inch.
122,096	5,200	.0167	....	
126,792	5,400	.0176	....	
131,488	5,600	.0183	....	
136,184	5,800	.0191	....	
140,880	6,000	.0197	.0020	E(5,000-6,000) = 4,000,000 pounds per square inch.
145,576	6,200	.0201	....	
150,272	6,400	.0208	....	First crack.
162,900	6,940	....	....	Ultimate strength.

No. 1553.

Marks, Vul. June 19.

Composition: Vulcanite cement, neat.

Water used in gauging, 25 per cent of cement, by weight.

Age, set in water, 171 days. (First day and last 3 days in air.)

Weight per cubic foot (immediately after being taken from the water), 133.6 pounds.

Dimensions, 23″.45 × 3″.92 × 6″.02.

Sectional area, 23.60 square inches.

Gauged length, 12″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,360	100	0.	0.	Initial load.
4,720	200	.0001	....	
7,080	300	.0003	....	
9,440	400	.0006	....	
11,800	500	.0009	0.	
14,160	600	.0012	....	
16,520	700	.0015	....	
18,880	800	.0018	....	
21,240	900	.0020	....	
23,600	1,000	.0023	0.	E (500–1,000) = 4,286,000 pounds per square inch.
28,320	1,200	.0031	....	
33,040	1,400	.0037	....	
37,760	1,600	.0044	....	
42,480	1,800	.0051	....	
47,200	2,000	.0059	.0001	E (1,000–2,000) = 3,429,000 pounds per square inch.
51,920	2,200	.0065	....	
56,640	2,400	.0070	....	
61,360	2,600	.0079	....	
66,080	2,800	.0085	....	
70,800	3,000	.0091	.0002	E (2,000–3,000) = 3,870,000 pounds per square inch.
75,520	3,200	.0095	....	
80,240	3,400	.0102	....	Crack at corner.
84,960	3,600	.0110	....	
89,680	3,800	.0116	....	
94,400	4,000	.0122	.0003	E (3,000–4,000) = 4,000,000 pounds per square inch.
99,120	4,200	.0128	....	
103,840	4,400	.0136	....	
108,560	4,600	.0144	....	
113,280	4,800	.0152	....	
118,000	5,000	.0161	.0005	E (4,000–5,000) = 3,243,000 pounds per square inch.
122,720	5,200	.0167	....	
127,440	5,400	.0175	....	
132,160	5,600	.0183	....	
136,880	5,800	.0192	....	
141,600	6,000	.0200	....	
153,200	6,490	....	....	Ultimate strength.

No. 1554.

Marks, Vul. 1:1 June 19.

Composition: Vulcanite cement, 1; sand, 1.

Water used in gauging, 30 per cent of cement, by weight.

Age, set in water, 173 days. (First day and last 5 days in air.)

Weight per cubic foot (immediately after being taken from the water), 140.3 pounds.

Dimensions, 23".90×3".91×6".02.

Sectional area, 23.54 square inches.

Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds	*Pounds.*	*Inch.*	*Inch.*	
2,354	100	0.	0.	Initial load.
4,708	200	.0004	....	
7,062	300	.0008	....	
9,416	400	.0010	....	
11,770	500	.0014	.0001	
14,124	600	.0018	....	
16,478	700	.0020	....	
18,832	800	.0023	....	
21,186	900	.0026	....	
23,540	1,000	.0030	.0003	E (500-1,000) = 4,286,000 pounds per square inch.
28,248	1,200	.0036	....	
32,956	1,400	.0040	....	
37,664	1,600	.0048	....	
42,372	1,800	.0056	....	
47,080	2,000	.0064	.0006	E (1,000-2,000) = 3,870,000 pounds per square inch.
51,788	2,200	.0071	....	
56,496	2,400	.0077	....	
61,204	2,600	.0083	....	
65,912	2,800	.0091	....	
70,620	3,000	.0100	.0010	E (2,000-3,000) = 3,750,000 pounds per square inch.
75,328	3,200	.0108	....	
80,036	3,400	.0115	....	
84,744	3,600	.0122	....	
89,452	3,800	.0130	....	
94,160	4,000	.0139	.0016	E (3,000-4,000) = 3,636,000 pounds per square inch.
98,868	4,200	.0149	....	
103,576	4,400	.0159	....	
108,284	4,600	.0168	....	Crack at corner.
112,992	4,800	.0178	....	
117,700	5,000	.0188	.0024	E (4,000-5,000) = 2,927,000 pounds per square inch.
122,408	5,200	.0203	....	
127,116	5,400	.0215	....	
131,824	5,600	.0229	....	
136,532	5,800	.0237	....	
141,240	6,000	.0248	.0044	E (5,000-6,000) = 3,000,000 pounds per square inch.
163.400	6,940	....	....	Ultimate strength.

No. 1555.

Marks, Vul. 1:1 June 19.

Composition: Vulcanite cement, 1; fine gravel, 1.

Water used in gauging, 25 per cent of cement, by weight.

Age, set in water, 173 days. (First day and last 5 days in air.)

Weight per cubic foot (immediately after being taken from the water), 143.9 pounds.

Dimensions, 23".95 × 3".96 × 6".01.

Sectional area, 23.80 square inches.

Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,380	100	0.	0.	Initial load.
4,760	200	.0002	....	
7,140	300	.0005	....	
9,520	400	.0008	....	
11,900	500	.0011	.0001	
14,280	600	.0016	....	
16,660	700	.0020	....	
19,040	800	.0025	....	
21,420	900	.0029	....	
23,800	1,000	.0034	.0005	E (500–1,000) = 3,158,000 pounds per square inch.
28,560	1,200	.0043	....	
33,320	1,400	.0054	....	
38,080	1,600	.0062	....	
42,840	1,800	.0071	....	
47,600	2,000	.0080	.0013	E (1,000–2,000) = 3,158,000 pounds per square inch.
52,360	2,200	.0091	....	
57,120	2,400	.0100	....	
61,880	2,600	.0109	....	
66,640	2,800	.0119	....	
71,400	3,000	.0128	.0019	E (2,000–3,000) = 2,857,000 pounds per square inch.
76,160	3,200	.0140	....	
80,920	3,400	.0148	....	
85,680	3,600	.0160	....	
90,440	3,800	.0172	....	
95,200	4,000	.0184	.0029	E (3,000–4,000) = 2,609,000 pounds per square inch.
99,960	4,200	.0196	....	
104,720	4,400	.0211	....	
109,480	4,600	.0227	....	
114,240	4,800	.0249	....	Ultimate strength

No. 1556.

Marks, Vul. 1:1 June 19.

Composition: Vulcanite cement, 1; coarse gravel, 1.

Water used in gauging, 23.8 per cent of cement, by weight.

Age, set in water, 173 days. (First day and last 5 days in air.)

Weight per cubic foot (immediately after being taken from the water), 146.4 pounds.

Dimensions, 24".00×3".95×6".06.

Sectional area, 23.94 square inches.

Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,394	100	0.	0.	Initial load.
4,788	200	.0003	....	
7,184	300	.0007	....	
9,576	400	.0011	....	
11,970	500	.0015	.0002	
14,364	600	.0020	....	
16,758	700	.0024	....	
19,152	800	.0029	....	
21,546	900	.0033	....	
23,940	1,000	.0038	.0006	E (500-1,000)=3,158,000 pounds per square inch.
28,728	1,200	.0047	....	
33,516	1,400	.0056	....	
38,304	1,600	.0067	....	
43,092	1,800	.0078	....	
47,880	2,000	.0086	.0014	E (1,000-2,000)=3,000,000 pounds per square inch.
52,668	2,200	.0096	....	
57,456	2,400	.0105	....	
62,244	2,600	.0113	....	
67,032	2,800	.0124	....	
71,820	3,000	.0134	.0020	E (2,000-3,000)=2,857,000 pounds per square inch.
76,608	3,200	.0150	....	
81,396	3,400	.0160	....	
86,184	3,600	.0179	....	
90,972	3,800	.0185	....	
95,760	4,000	.0197	.0033	E (3,000-4,000)=2,400,000 pounds per square inch.
100,548	4,200	.0225	....	Crack at corner.
104,300	4,360	....	....	Ultimate strength.

No. 1557.

Marks, Vul. 1:1 June 19.

Composition: Vulcanite cement, 1; ½″ trap rock, 1.

Water used in gauging, 22.7 per cent of cement, by weight.

Age, set in water, 174 days. (First day and last 6 days in air.)

Weight per cubic foot (immediately after being taken from the water), 152.5 pounds.

Dimensions, 23″.96 × 4″.00 × 6″.06.

Sectional area, 24.24 square inches.

Gauged length, 12″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,424	100	0.	0.	Initial load.
4,848	200	.0002	....	
7,272	300	.0003	....	
9,696	400	.0005	....	
12,120	500	.0007	0.	
14,544	600	.0010	....	
16,968	700	.0014	....	
19,392	800	.0016	....	
21,816	900	.0018	....	
24,240	1,000	.0021	.0002	E (500-1,000)) = 5,000,000 pounds per square inch.
29,088	1,200	.0026	....	
33,936	1,400	.0031	....	
38,784	1,600	.0037	....	
43,632	1,800	.0043	....	
48,480	2,000	.0048	.0004	E (1,000-2,000) = 4,800,000 pounds per square inch.
53,328	2,200	.0054	....	
58,176	2,400	.0061	....	
63,024	2,600	.0067	....	
67,872	2,800	.0074	....	
72,720	3,000	.0080	.0007	E (2,000-3,000) = 4,138,000 pounds per square inch.
77,568	3,200	.0086	....	
82,416	3,400	.0092	....	
87,264	3,600	.0098	....	
92,112	3,800	.0106	....	
96,960	4,000	.0115	.0010	E (3,000-4,000) = 3,750,000 pounds per square inch.
101,808	4,200	.0122	....	
106,656	4,400	.0129	....	
111,504	4,600	.0135	....	
116,352	4,800	.0142	....	
121,200	5,000	.0150	.0015	E (4,000-5,000) = 4,000,000 pounds per square inch.
126,048	5,200	.0160	....	
130,896	5,400	.0170	....	
135,744	5,600	.0178	....	
140,592	5,800	.0189	....	
145,440	6,000	.0199	.0025	E (5,000-6,000) = 3,077,000 pounds per square inch.
150,288	6,200	.0219	....	
155,136	6,400	.0237	....	Ultimate strength.

No. 1558.

Marks, Vul. 1:1 June 19.

Composition: Vulcanite cement, 1; 2½" trap rock, 1.

Water used in gauging, 21.7 per cent of cement, by weight.

Age, set in water, 176 days. (First day and last 8 days in air.)

Weight per cubic foot (immediately after being taken from the water), 154.4 pounds.

Dimensions, 24".00 × 4".05 × 6".05.

Sectional area, 24.50 square inches.

Gauged length, 12".

One end of specimen porous, outside the gauged length.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,450	100	0.	0.	Initial load.
4,900	200	.0005	....	
7,350	300	.0011	....	
9,800	400	.0016	....	
12,250	500	.0020	.0008	
14,700	600	.0025	....	
17,150	700	.0030	....	
19,600	800	.0034	....	
22,050	900	.0037	....	
24,500	1,000	.0041	.0011	E(500-1,000)=3,333,000 pounds per square inch.
29,400	1,200	.0049	....	
34,300	1,400	.0056	....	
39,200	1,600	.0064	....	
44,100	1,800	.0072	....	
49,000	2,000	.0080	.0016	E(1,000-2,000)=3,529,000 pounds per square inch.
53,900	2,200	.0088	....	
58,800	2,400	.0095	....	
63,700	2,600	.0103	....	
68,600	2,800	.0111	....	
73,500	3,000	.0120	.0024	E(2,000-3,000)=3,750,000 pounds per square inch.
78,400	3,200	.0129	....	
83,300	3,400	.0138	....	
88,200	3,600	.0145	....	
93,100	8,800	.0155	....	
98,000	4,000	.0165	.0034	E(3,000-4,000)=3,429,000 pounds per square inch. Corner cracked.
102,900	4,200	.0184	....	Ultimate strength.

No. 1559.

Marks, Vul. 1:1 June 19.

Composition: Vulcanite cement, 1; cinders, 1.

Water used in gauging, 35 per cent of cement, by weight.

Age, set in water, 174 days. (First day and last 6 days in air.)

Weight per cubic foot (immediately after being taken from the water), 121.2 pounds.

Dimensions, 23″.90×3″.97×6″.01.

Sectional area, 23.86 square inches.

Gauged length, 12″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,386	100	0.	0.	Initial load.
4,772	200	.0003	....	
7,158	300	.0005	....	
9,544	400	.0007	....	
11,930	500	.0010	0.	
14,316	600	.0014	....	
16,702	700	.0018	....	
19,088	800	.0021	....	
21,474	900	.0025	....	
23,860	1,000	.0029	0.	E(500-1,000)=3,158,000 pounds per square inch.
28,632	1,200	.0037	....	
33,404	1,400	.0045	....	
38,176	1,600	.0056	....	
42,948	1,800	.0065	....	
47,720	2,000	.0075	.0003	E(1,000-2,000)=2,791,000 pounds per square inch.
52,492	2,200	.0084	....	
57,264	2,400	.0094	....	
62,036	2,600	.0105	....	
66,808	2,800	.0114	....	Crack at corner.
69,900	2,930	....	....	Ultimate strength.

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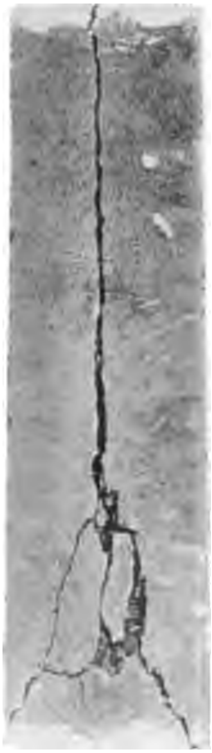


NO. 1560.

COMPOSITION, VULCANITE PORTLAND CEMENT 1, SAND 2.

APPEARANCE OF PRISM AFTER FRACTURE.

HELIOTYPE CO., BOSTON.

No. 1560.

Marks, Vul. 1:2, June 20.
Composition: Vulcanite cement, 1; sand, 2.
Water used in gauging, 38.6 per cent of cement, by weight.
Age, set in water, 173 days. (First 2 days and last 6 days in air.)
Weight per cubic foot (immediately after being taken from the water), 135.3 pounds.
Dimensions, 24".00×3".92×6".00.
Sectional area, 23.52 square inches.
Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,352	100	0.	0.	Initial load.
4,704	200	.0003	....	
7,056	300	.0006	....	
9,408	400	.0010	....	
11,760	500	.0012	.0001	
14,112	600	.0016	....	
16,464	700	.0020	....	
18,816	800	.0024	....	
21,168	900	.0029	....	
23,520	1,000	.0033	.0005	E (500-1,000)=3,529,000 pounds per square inch.
28,224	1,200	.0043	....	
32,928	1,400	.0051	....	
37,632	1,600	.0060	....	
42,336	1,800	.0071	....	
47,040	2,000	.0082	.0012	E(1,000-2,000)=2,857,000 pounds per square inch.
51,744	2,200	.0094	....	
56,448	2,400	.0108	....	
61,152	2,600	.0121	....	
65,856	2,800	.0135	....	
70,560	3,000	.0154	.0029	E(2,000-3,000)=2,182,000 pounds per square inch.
75,264	3,200	.0183	....	
77,200	3,280	....	....	Ultimate strength.

No. 1561.

Marks, Vul. 1:3, June 20.

Composition: Vulcanite cement, 1; sand, 3.

Water used in gauging, 40 per cent of cement, by weight.

Age, set in water, 173 days. (First 2 days and last 6 days in air.)

Weight per cubic foot (immediately after being taken from the water), 135.5 pounds.

Dimensions, 23″.95 × 3″.98 × 6″.02.

Sectional area, 23.96 square inches.

Gauged length, 12″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,396	100	0.	0.	Initial load.
4,792	200	.0004	....	
7,188	300	.0009	....	
9,584	400	.0014	....	
11,980	500	.0018	.0005	
14,376	600	.0023	....	
16,772	700	.0028	....	
19,168	800	.0032	....	
21,564	900	.0039	....	
23,960	1,000	.0045	.0010	E(500-1,000) = 2,727,000 pounds per square inch.
26,356	1,100	.0051	....	
28,752	1,200	.0056	....	
31,148	1,300	.0062	....	
33,544	1,400	.0068	....	
35,940	1,500	.0076	.0017	E(1,000-1,500) = 2,500,000 pounds per square inch.
38,336	1,600	.0084	....	
40,732	1,700	.0092	....	
43,128	1,800	.0099	....	
45,524	1,900	.0106	....	
47,920	2,000	.0115	.0028	E(1,500-2,000) = 2,143,000 pounds per square inch.
50,316	2,100	.0126	....	
52,712	2,200	.0134	....	
55,108	2,300	.0144	....	
57,504	2,400	.0156	....	
59,900	2,500	.0167	.0045	E(2,000-2,500) = 1.714,000 pounds per square inch.
62,296	2,600	.0189	....	
69,800	2,910	....	....	Ultimate strength.

No. 1562.

Marks, Vul. 1:1:2, June 20.

Composition: Vulcanite cement, 1; sand, 1; ½″ trap rock, 2.

Water used in gauging, 40 per cent of cement, by weight.

Age, set in water, 173 days. (First 2 days and last 6 days in air.)

Weight per cubic foot (immediately after being taken from the water), 149.1 pounds.

Dimensions, 23″.92 × 3″.99 × 6″.02.

Sectional area, 24.02 square inches.

Gauged length, 12″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,402	100	0.	0.	Initial load.
4,804	200	.0004		
7,206	300	.0007		
9,608	400	.0010		
12,010	500	.0013	.0003	
14,412	600	.0016		
16,814	700	.0020		
19,216	800	.0024		
21,618	900	.0027		
24,020	1,000	.0032	.0005	E(500-1,000) = 3,529,000 pounds per square inch.
28,824	1,200	.0038		
33,628	1,400	.0045		
38,432	1,600	.0054		
43,236	1,800	.0061		
48,040	2,000	.0071	.0012	E(1,000-2,000) = 3,750,000 pounds per square inch.
52,844	2,200	.0080		
57,648	2,400	.0088		
62,452	2,600	.0097		
67,256	2,800	.0104		
72,060	3,000	.0115	.0020	E (2,000-3,000) = 3,333,000 pounds per square inch. Corner cracked.
76,864	3,200	.0125		
81,668	3,400	.0138		
86,472	3,600	.0150		
91,276	3,800	.0161		
96,080	4,000	.0176	.0040	E(3,000-4,000) – 2,927,000 pounds per square inch.
100,884	4,200	.0199		
105,688	4,400	.0221	.0058	
109,600	4,560			Ultimate strength.

No. 1563.

Marks, Vul. 1:1:2, June 20.

Composition: Vulcanite cement, 1; sand, 1; ½″ trap rock, 2.

Water used in gauging, 29.2 per cent of cement by weight.

Age, set in water, 173 days. (First 2 days and last 6 days in air.)

Weight per cubic foot (immediately after being taken from the water), 152 pounds.

Dimensions, 24″.00 × 3″.94 × 6″.01.

Sectional area, 23.68 square inches.

Gauged length, 12″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,368	100	0.	0.	Initial load.
4,736	200	.0002	....	
7,104	300	.0003	....	
9,472	400	.0005	....	
11,840	500	.0008	.0001	
14,208	600	.0011	....	
16,576	700	.0014	....	
18,944	800	.0016	....	
21,312	900	.0020	....	
23,680	1,000	.0022	.0003	E(500-1,000) = 5,000,000 pounds per square inch.
28,416	1,200	.0026	....	
33,152	1,400	.0031	....	
37,888	1,600	.0036	....	
42,624	1,800	.0040	....	
47,360	2,000	.0045	.0003	E(1,000-2,000) = 5,217,000 pounds per square inch.
52,096	2,200	.0050	....	
56,832	2,400	.0056	....	
61,568	2,600	.0063	....	
66,304	2,800	.0070	....	
71,040	3,000	.0079	.0006	E(2,000-3,000) = 3,870,000 pounds per square inch.
75,776	3,200	.0089	....	
80,512	3,400	.0099	....	
85,248	3,600	.0109	....	
89,984	3,800	.0120	....	
94,720	4,000	.0135	.0018	E(3,000-4,000) = 2,727,000 pounds per square inch.
99,000	4,180	....	....	Ultimate strength.

No. 1564.

Marks, Vul. 1:2:3, June 20.

Composition: Vulcanite cement, 1; sand, 2; ½" trap rock, 3.

Water used in gauging, 45 per cent of cement, by weight.

Age, set in water, 173 days. (First 2 days and last 6 days in air.)

Weight per cubic foot (immediately after being taken from the water), 150.8 pounds.

Dimensions, 24".00 × 3".90 × 6".00.

Sectional area, 23.40 square inches.

Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,340	100	0.	0.	Initial load.
4,680	200	.0001	....	
7,020	300	.0003	....	
9,360	400	.0006	....	
11,700	500	.0010	0.	
14,040	600	.0013	....	
16,380	700	.0016	....	
18,720	800	.0020	....	
21,060	900	.0023	....	
23,400	1,000	.0026	.0003	E (500-1,000) = 4,615,000 pounds per square inch.
28,080	1,200	.0034	....	
32,760	1,400	.0042	....	
37,440	1,600	.0050	....	
42,120	1,800	.0059	....	
46,800	2,000	.0072	.0013	E (1,000-2,000) = 3,333,000 pounds per square inch.
51,480	2,200	.0081	....	
56,160	2,400	.0091	....	
60,840	2,600	.0102	....	
65,520	2,800	.0113	....	
70,200	3,000	.0125	.0025	E (2,000-3,000) = 2,927,000 pounds per square inch.
74,880	3,200	.0144	....	
79,560	3,400	.0160	....	
84,240	3,600	.0185	....	
86,600	3,700	....	....	Ultimate strength.

No. 1565.

Marks, Vul. 1:2:4, June 22.

Composition: Vulcanite cement, 1; sand, 2; ½" trap rock, 4.

Water used in gauging, 42.9 per cent of cement, by weight.

Age, set in water, 175 days. (First day and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 150.3 pounds.

Dimensions, 24".04 × 3".89 × 6".02.

Sectional area, 23.42 square inches.

Gauged length, 12".

Porous at one end of prism.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,342	100	0.	0.	Initial load.
4,684	200	.0005	....	
7,026	300	.0008	....	
9,368	400	.0012	....	
11,710	500	.0017	.0002	
14,052	600	.0022	....	
16,394	700	.0026	....	
18,736	800	.0032	....	
21,078	900	.0040	....	
23,420	1,000	.0049	.0010	E (500-1,000) = 2,500,000 pounds per square inch.
28,104	1,200	.0078	....	
32,788	1,400	.0129	....	
34,600	1,480	.0323	....	Ultimate strength.

No. 1566.

Marks, Vul. 1:3:6, June 25.

Composition: Vulcanite cement, 1; sand, 3; ½" trap rock, 6.

Water used in gauging, 40 per cent of cement, by weight.

Age, set in water, 168 days. (First 7 days and last 4 days in air.)

Weight per cubic foot (immediately after being taken from the water), 155.8 pounds.

Dimensions, 24".05 × 3".90 × 6".06.

Sectional area, 23.63 square inches.

Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,363	100	0.	0.	Initial load.
4,726	200	.0002	....	
7,089	300	.0005	....	
9,452	400	.0010	....	
11,815	500	.0016	.0002	
14,178	600	.0024	....	
16,541	700	.0031	....	
18,904	800	.0041	....	
21,267	900	.0051	....	
23,630	1,000	.0070	.0020	E (500-1,000) = 1,667,000 pounds per square inch.
25,993	1,100	.0089	....	
28,356	1,200	.0111	....	
30,719	1,300	.0146	....	
33,082	1,400	.0225	....	
33,400	1,410	....	....	Ultimate strength.

No. 1567.

Marks, Vul. 1:1:2, June 22.

Composition: Vulcanite cement, 1; sand, 1; 2½″ trap rock, 2.

Water used in gauging, 29.2 per cent of cement, by weight.

Age, set in water, 171 days. (——— and last 6 days in air.)

Weight per cubic foot (immediately after being taken from the water), 153.9 pounds.

Dimensions, 24″.03 × 3″.99 × 6″.00.

Sectional area, 23.94 square inches.

Gauged length, 12″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,394	100	0.	0.	Initial load.
4,788	200	.0003		
7,182	300	.0005		
9,576	400	.0007		
11,970	500	.0010	.0001	
14,364	600	.0013		
16,758	700	.0016		
19,152	800	.0020		
21,546	900	.0024		
23,940	1,000	.0027	.0005	E (500-1,000) = 4,615,000 pounds per square inch.
28,728	1,200	.0035		
33,516	1,400	.0043		
38,304	1,600	.0051		
43,092	1,800	.0065		
47,880	2,000	.0088	.0031	E (1,000-2,000) = 3,429,000 pounds per square inch.
52,668	2,200			Ultimate strength.

No. 1568.

Marks, Vul. 1:2:3, June 22.

Composition: Vulcanite cement, 1; sand, 2; 2½″ trap rock, 3.

Water used in gauging, 37.5 per cent of cement, by weight.

Age, set in water, 175 days. (——— and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 154.9 pounds.

Dimensions, 24″.08 × 3″.90 × 6″.00.

Sectional area, 23.40 square inches.

Gauged length, 12″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,340	100	0.	0.	Initial load.
4,680	200	.0003		
7,020	300	.0008		
9,360	400	.0011		
11,700	500	.0015	.0004	
14,040	600	.0020		
16,380	700	.0024		
18,720	800	.0029		
21,060	900	.0035		
23,400	1,000	.0040	.0012	E (500-1,000) = 3,529,000 pounds per square inch.
28,080	1,200	.0054		
32,760	1,400	.0075		
37,440	1,600	.0139	.0068	
39,400	1,680			Ultimate strength.

Fracture occurred in part through pieces of the 2½″ broken stone.

No. 1569.

Marks, Vul. 1:2:4, June 22.

Composition: Vulcanite cement, 1; sand, 2; 2½" trap rock, 4.

Water used in gauging, 42.9 per cent of cement, by weight.

Age, set in water, 175 days. (——— and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 154.9 pounds.

Dimensions, 24".20×4".00×6".05.

Sectional area, 24.20 square inches.

Gauged length, 12".

Porous spots along length of prism.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,420	100	0.	0.	Initial load.
4,840	200	.0004	....	
7,260	300	.0007	....	
9,680	400	.0013	....	
12,100	500	.0018	.0006	
14,520	600	.0023	....	
16,940	700	.0030	....	
19,360	800	.0038	....	
21,780	900	.0047	....	
24,200	1,000	.0065	.0028	E (500-1,000)=2,400,000 pounds per square inch.
26,620	1,100	.0088	....	
29,040	1,200	.0143	.0079	
29,200	1,210	....	....	Ultimate strength.

No. 1570.

Marks, Vul. 1:3:6, June 26.

Composition: Vulcanite cement, 1; sand, 3; 2½" trap rock, 6.

Water used in gauging, 50 per cent of cement, by weight.

Age, set in water, 171 days. (First 6 days and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 158.1 pounds.

Dimensions, 24".03×4".04×6".05.

Sectional area, 24.44 square inches.

Gauged length, 12".

Porous places along the prism.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,444	100	0.	0.	Initial load.
4,888	200	.0005	....	
7,332	300	.0012	....	
9,776	400	.0019	....	
12,220	500	.0030	.0013	E (100-500)=2,824,000 pounds per square inch.
14,664	600	.0046	....	
17,108	700	.0089	....	
19,300	790	.0176	....	Ultimate strength.

No. 1571.

Marks, Vul. 1:1:2, June 26.
Composition: Vulcanite cement, 1; sand, 1; cinders, 2.
Water used in gauging, 29.2 per cent of cement, by weight.
Age, set in water, 171 days. (First 6 days and last 10 days in air.)
Weight per cubic foot (immediately after being taken from the water), 124.2 pounds.
Dimensions, 24″.20 × 3″.94 × 6″.02.
Sectional area, 23.72 square inches.
Gauged length, 12″.
Surface generally porous.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,372	100	0.	0.	Initial load.
4,744	200	.0004	....	
7,116	300	.0009	....	
9,488	400	.0014	....	
11,860	500	.0018	.0002	
14,232	600	.0024	....	
16,604	700	.0029	....	
18,976	800	.0033	....	
21,348	900	.0040	....	
23,720	1,000	.0045	.0004	E (500–1,000) = 2,400,000 pounds per square inch.
28,464	1,200	.0058	....	
33,208	1,400	.0072	....	
37,952	1,600	.0088	....	
42,696	1,800	.0107	....	
47,440	2,000	.0129	.0015	E (1,000–2,000) = 1,644,000 pounds per square inch.
52,184	2,200	.0178	....	Ultimate strength.

No. 1572.

Marks, Vul. 1:2:3, June 26.

Composition: Vulcanite cement, 1; sand, 2; cinders, 3.

Water used in gauging, 43.8 per cent of cement, by weight.

Age, set in water, 171 days. (First 6 days and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 125.4 pounds.

Dimensions, 24″.20 × 3″.87 × 6″.00.

Sectional area, 23.22 square inches.

Gauged length, 12″.

Surface of prism generally spongy.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,322	100	0.	0.	Initial load.
4,644	200	.0004	....	
6,966	300	.0009	....	
9,288	400	.0015	....	
11,610	500	.0022	.0003	
13,932	600	.0031	....	
16,254	700	.0042	....	
18,576	800	.0053	....	
20,898	900	.0066	....	
23,220	1,000	.0080	.0019	E (500-1,000) = 1,429,000 pounds per square inch.
25,542	1,100	.0100	....	
27,864	1,200	.0118	....	
30,186	1,300	.0146	....	
32,508	1,400	.0205	....	Ultimate strength.

No. 1573.

Marks, 1:2:4, June 26.

Composition: Vulcanite cement, 1; sand, 2; cinders, 4.

Water used in gauging, 57.1 per cent of cement, by weight.

Age, set in water, 171 days. (First 6 days and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 122 pounds.

Dimensions, 24″.22 × 3″.99 × 6″.00.

Sectional area, 23.94 square inches.

Gauged length, 12″.

Surface of prism somewhat porous.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,394	100	0.	0.	Initial load.
4,788	200	.0006	....	
7,182	300	.0016	....	
9,576	400	.0027	....	
11,970	500	.0040	.0006	E (100-500) = 1,412,000 pounds per square inch.
14,364	600	.0061	....	
16,758	700	.0093	....	
18,300	764	.0142	....	
19,152	800	.0194	.0105	
19,152	800	.0285	....	Second application of load. Ultimate strength.

Sustained 800 pounds per square inch about one-half minute upon second application, then rapidly yielded and completed fracture.

No. 1574.

Marks, Vul. 1: 3: 6, June 27.

Composition: Vulcanite cement, 1; sand, 3; cinders, 6.

Water used in gauging, 80 per cent of cement, by weight.

Age, set in water, 170 days. (First 5 days and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 119.2 pounds.

Dimensions, 24".08 × 3".86 × 6".05.

Sectional area, 23.35 square inches.

Gauged length, 12".

Surface somewhat porous.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,335	100	0.	0.	Initial load.
4,670	200	.0008	....	
7,005	300	.0020	....	
9,340	400	.0038	....	
11,675	500	.0061	.0017	E (100-500) = 1,091,000 pounds per square inch.
14,010	600	.0097	....	
16,345	700	.0154	....	
17,300	740	....	....	Ultimate strength.

No. 1575.

Marks, Vul. 1: 1: 2, June 27.

Composition: Vulcanite cement, 1; sand, 1; coarse gravel, 2.

Water used in gauging, 33.3 per cent of cement, by weight.

Age, set in water, 170 days. (First 5 days and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 146.3 pounds.

Dimensions, 24".00 × 3".96 × 5".97.

Sectional area, 23.64 square inches.

Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,364	100	0.	0.	Initial load.
4,728	200	.0004	....	
7,092	300	.0009	....	
9,456	400	.0014	....	
11,820	500	.0019	.0004	
14,184	600	.0025	....	
16,548	700	.0031	....	
18,912	800	.0037	....	
21,276	900	.0042	....	
23,640	1,000	.0049	.0012	E (500-1,000) = 2,727,000 pounds per square inch.
28,368	1,200	.0063	....	
33,096	1,400	.0074	....	
37,824	1,600	.0088	....	
42,552	1,800	.0104	....	
47,280	2,000	.0120	.0032	E (1,000-2,000) = 2,353,000 pounds per square inch.
52,008	2,200	.0140	....	
56,736	2,400	.0161	....	
61,464	2,600	.0265	....	Ultimate strength.

No. 1576.

Marks, Vul. 1: 2: 3, June 27.

Composition: Vulcanite cement, 1; sand, 2; coarse gravel, 3.

Water used in gauging, 37.5 per cent of cement, by weight.

Age, set in water, 170 days. (First 5 days and last 10 days in air.)

Weight per cubic foot (immediately after being taken from the water), 146.8 pounds.

Dimensions, 24".00 × 3".90 × 6".03.

Sectional area, 23.52 square inches.

Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,352	100	0.	0.	Initial load.
4,704	200	.0005	....	
7,056	300	.0009	....	
9,408	400	.0013	....	
11,760	500	.0017	.0004	
14,112	600	.0023	....	
16,464	700	.0027	....	
18,816	800	.0034	....	
21,168	900	.0040	....	
23,520	1,000	.0044	.0010	E (500-1,000) = 2,857,000 pounds per square inch.
28,224	1,200	.0057	....	
32,928	1,400	.0071	....	
37,632	1,600	.0088	....	
42,336	1,800	.0106	....	
47,040	2,000	.0133	.0034	E (1,000-2 000) = 1,846,000 pounds per square inch.
48,500	2,060	....	....	Ultimate strength.

No. 1577.

Marks, Vul. 1: 2: 4, June 27.
Composition: Vulcanite cement, 1; sand, 2; coarse gravel, 4.
Water used in gauging, 42.9 per cent of cement, by weight.
Age, set in water, 171 days. (First 5 days and last 11 days in air.)
Weight per cubic foot (immediately after being taken from the water), 148.3 pounds.
Dimensions, 24".03 × 3".99 × 5".99.
Sectional area, 23.90 square inches.
Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,390	100	0.	0.	Initial load.
4,780	200	.0005	....	
7,170	300	.0011	....	
9,560	400	.0016	....	
11,950	500	.0023	.0007	
14,340	600	.0030	....	
16,730	700	.0037	....	
19,120	800	.0045	....	
21,510	900	.0052	....	
23,900	1,000	.0062	.0020	E (500-1,000) = 2,308,000 pounds per square inch.
26,290	1,100	.0071	....	
28,680	1,200	.0081	....	
31,070	1,300	.0092	....	
33,460	1,400	.0106	....	
35,850	1,500	.0123	.0045	E (1,000-1,500) = 1,667,000 pounds per square inch
38,240	1,600	.0150	....	
40,630	1,700	.0210	....	Ultimate strength.

No. 1578.

Marks, Vul. 1: 3: 6, June 29.
Composition: Vulcanite cement, 1; sand, 3; coarse gravel, 6.
Water used in gauging, 80 per cent of cement, by weight.
Age, set in water, 169 days. (First 12 days and last 11 days in air.)
Weight per cubic foot (immediately after being taken from the water), 144.2 pounds.
Dimensions, 24".00 × 3".83 × 6".00.
Sectional area, 22.98 square inches.
Gauged length, 12".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,298	100	0.	0.	Initial load.
4,596	200	.0010	....	
6,894	300	.0025	....	
9,192	400	.0047	....	
11,490	500	.0090	.0050	E (100-500) = 1,200,000 pounds per square inch.
13,300	580	.0116	....	Ultimate strength.

TABULATION OF THE COMPRESSIVE STRENGTH AND ELASTIC PROPERTIES OF CEMENT, MORTAR, AND CONCRETE PRISMS.

Prisms 4″ by 6″ by 24″ long. Set in water, with initial and final periods in air. Weight taken immediately after they were removed from the water. Vulcanite brand of Portland cement used.

Elastic properties observed on a gauged length of 12″.

Quantities taken by weight. Water used stated in per cent of cement, by weight.

No. of test.	Composition.					Weight per cubic foot	Age	Compressive strength per square inch.	Modulus of elasticity between loads per square inch of—				Permanent set on gauged length of 12″, after loads in pounds per square inch of—			
	Cement.	Sand	Stone or cinder.	Kind of stone or cinder.	Water.				100 and 500.	500 and 1,000.	1,000 and 2,000.	2,000 and 3,000.	500.	1,000.	2,000.	3,000.
					Per cent	*Pounds.*	*Days*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
1552	Neat.	....	....	....	20.0	137.2	171	6,940	....	5,000,000	3,750,000	3,870,000	0.	.0001	.0004	.0009
1553	Neat.	....	....	....	25.0	133.6	171	6,490	....	4,286,000	3,429,000	3,870,000	0.	0.	.0001	.0002
1554	1	1	....	....	30.0	140.3	173	6,940	....	4,286,000	3,870,000	3,750,000	.0001	.0003	.0006	.0010
1555	1	....	1	¼″ gravel........	25.0	143.9	173	4,800	....	3,158,000	3,158,000	2,857,000	.0001	.0005	.0013	.0019
1556	1	....	1	⅜″ gravel........	23.8	146.4	173	4,360	....	3,158,000	3,000,000	2,857,000	.0002	.0006	.0014	.0020
1557	1	....	1	½″ trap rock.....	22 7	152.5	174	6,400	....	5,000,000	4,800,000	4,138,000	0.	.0002	.0004	.0007
1558	1	....	1	2½″ trap rock.....	21.7	154.4	176	4,200	....	3,333,000	3,529,000	3,750,000	.0008	.0011	.0016	.0024
1559	1	....	1	Cinders..........	35.0	121.2	174	2,930	....	3,158,000	2,791,000	....	0.	0.	.0003	....
1560	1	2	....	....	38.6	135.3	173	3,280	....	3,529,000	2,857,000	2,182,000	.0001	.0005	.0012	.0029
1561	1	3	....	....	40.0	135.5	173	2,910	....	2,727,000	2,308,000	....	.0005	.0010	.0028	....
1562	1	1	2	½″ trap rock......	40.0	149.1	173	4,560	....	3,529,000	3,750,000	3,333,000	.0003	.0005	.0012	.0020
1563	1	1	2	.....do..........	29.2	152 0	173	4,180	....	5,000,000	5,217,000	3,870,000	.0001	.0003	.0003	.0006
1564	1	2	3	.....do..........	45.0	150.8	173	3,700	....	4,615,000	3,333,000	2,927,000	0.	.0003	.0013	.0025
1565	1	2	4	.....do..........	42.9	150.3	175	1,480	....	2,500,000	....	....	.0002	.0010	....	....
1566	1	3	6	.....do..........	40.0	155.8	168	1,410	....	1,667,000	....	....	.0002	.0020	....	....
1567	1	1	2	2½″ trap rock.....	29.2	153.9	171	2,200	....	4,615,000	3,429,000	....	.0001	.0005	.0031	....
1568	1	2	3	.....do..........	37.5	154.9	175	1,680	....	3,529,000	....	....	.0004	.0012	....	....
1569	1	2	4	.....do..........	42.9	154.9	175	1,210	....	2,400,000	....	....	.0006	.0028	....	....
1570	1	3	6	.....do..........	50.0	158.1	171	790	2,824,000	....	....	....	.0013	....	....	....
1571	1	1	2	Cinders..........	29.2	124.2	171	2,200	....	2,400,000	1,644,000	....	.0002	.0004	.0015	....
1572	1	2	3	.....do..........	43.8	125.4	171	1,400	....	1,429,000	....	....	.0003	.0019	....	....
1573	1	2	4	.....do..........	57.1	122.0	171	800	1,412,000	....	....	....	.0006	....	....	....
1574	1	3	6	.....do..........	80.0	119.2	170	740	1,091,000	....	....	....	.0017	....	....	....
1575	1	1	2	⅜″ gravel........	33.3	146.3	170	2,600	....	2,727,000	2,353,000	....	.0004	.0012	.0032	....
1576	1	2	3	.....do..........	37.5	146.8	170	2,060	....	2,857,000	1,846,000	....	.0004	.0010	.0034	....
1577	1	2	4	.....do..........	42.9	148.3	171	1,700	....	2,308,000	....	....	.0007	.0020	....	....
1578	1	3	6	.....do..........	80.0	144.2	169	580	1,200,000	....	....	....	.0050	....	....	....

CONCRETE CUBES.

COMPRESSIVE STRENGTH AND ELASTIC PROPERTIES.

COMPRESSIVE ELASTIC PROPERTIES.

No. 1510.

Marks, 315.

Composition: Alpha Portland cement, 1; sand, 2; 1½" and 2½" trap rock, 4.

Water used in mortar, 61.2 per cent of cement, by weight.

Age, set in air, 4 years 1 day.

Weight per cubic foot, 151.4 pounds.

Dimensions, 11".99 × 12".04 × 12".05.

Sectional area, 145.08 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,508	100	0.	0.	Initial load.
29,016	200	.0001	0.	
43,524	300	.0002	0.	
58,032	400	.0004	0.	
72,540	500	.0006	.0001	
87,048	600	.0008	.0001	E = 3,571,000 pounds per square inch.
101,556	700	.0010	.0002	
116,064	800	.0012	.0003	
130,572	900	.0015	.0004	
145,080	1,000	.0018	.0005	E = 3,462,000 pounds per square inch.
159,588	1,100	.0021	.0005	
174,096	1,200	.0024	.0006	
188,604	1,300	.0028	.0008	
203,112	1,400	.0032	.0010	
217,620	1,500	.0037	.0012	E = 1,724,000 pounds per square inch.
232,128	1,600	.0042	.0014	
246,636	1,700	.0049	.0019	
261,144	1,800	.0057	.0023	
275,652	1,900	.0067	.0029	
290,160	2,000	.0077	.0035	
304,668	2,100	.0089	.0042	
319,176	2,200	.0101	.0049	
333,684	2,300	.0117	.0061	
348,192	2,400	.0134	.0072	
362,700	2,500	.0138	.0079	
403,000	2,780	....	....	Ultimate strength.

No. 1511.

Marks, 316.

Composition: Alpha Portland cement, 1; sand, 2; 1½" and 2½" trap rock, 4.

Water used in mortar, 61.2 per cent of cement, by weight.

Age, set in air, 4 years 1 day.

Weight per cubic foot, 148.4 pounds.

Dimensions, 11".87 × 12".07 × 12".02.

Sectional area, 145.08 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*ch.*	
14 508	100	0.	.	Initial load.
29.016	200	.0001	0.	
43,524	300	.0002	0.	
58 032	400	.0004	0.	
72,540	500	.0006	0.	
87.048	600	.0008	.0001	E=3,571,000 pounds per square inch.
101,556	700	.0010	.0002	
116,064	800	.0012	.0002	
130,572	900	.0015	.0003	
145,080	1,000	.0017	.0004	E=3,462,000 pounds per square inch.
159,588	1,100	.0019	.0005	
174,096	1,200	.0022	.0006	
188,604	1,300	.0026	.0007	
203,112	1,400	.0028	.0008	
217,620	1,500	.0031	.0009	E=2,273,000 pounds per square inch.
232,128	1,600	.0036	.0011	
246,636	1,700	.0040	.0012	
261,144	1,800	.0044	.0014	
275,652	1,900	.0049	.0017	
290,160	2,000	.0056	.0021	
304,668	2,100	.0061	.0024	
319,176	2,200	.0070	.0029	
333,684	2,300	.0080	.0036	
348,192	2,400	.0088	.0042	
362,700	2,500	.0103	.0055	
377,208	2,600	.0127	.0075	Crack.
416,000	2,870	....	....	Ultimate strength.

No. 1512.

Marks, 393.
Composition: Alpha Portland cement, 1; sand, 2; 2½″ trap rock, 4.
Water used in mortar, 58.3 per cent of cement, by weight.
Age, set in air, 4 years.
Weight per cubic foot, 151.7 pounds.
Dimensions, 11″.90 × 12″.05 × 12″.04.
Sectional area, 145.08 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,508	100	0.	0.	Initial load.
29,016	200	.0001	0.	
43,524	300	.0003	0.	
58,032	400	.0005	0.	
72,540	500	.0007	.0001	
87,048	600	.0010	.0002	E = 3,125,000 pounds per square inch.
101,556	700	.0012	.0003	
116,064	800	.0014	.0003	
130,572	900	.0017	.0005	
145,080	1,000	.0020	.0006	E = 3,214,000 pounds per square inch.
159,588	1,100	.0023	.0007	
174,096	1,200	.0026	.0008	
188,604	1,300	.0030	.0009	
203,112	1,400	.0033	.0010	
217,620	1,500	.0036	.0011	E = 2,000,000 pounds per square inch.
232,128	1,600	.0040	.0013	
246,636	1,700	.0045	.0015	
261,144	1,800	.0050	.0017	
275,652	1,900	.0056	.0020	
290,160	2,000	.0063	.0024	
304,668	2,100	.0070	.0027	
319,176	2,200	.0077	.0031	
333,684	2,300	.0086	.0037	
348,192	2,400	.0098	.0044	
362,700	2,500	.0112	.0053	
377,208	2,600	.0148	.0080	Crack.
391,716	2,700	.0190	.0105	
406,224	2,800	.0274	.0161	
421,000	2,900	....	....	Ultimate strength.

No. 1513.

Marks, 394.
Composition: Alpha Portland cement, 1; sand, 2; 2½″ trap rock, 4.
Water used in mortar, 58.3 per cent of cement, by weight.
Age, set in air, 4 years.
Weight per cubic foot, 152.3 pounds.
Dimensions, 11″.93 × 12″.03 × 12″.02.
Sectional area, 144.60 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,460	100	0.	0.	Initial load.
28,920	200	.0002	0.	
43,380	300	.0004	.0001	
57,840	400	.0007	.0002	
72,300	500	.0010	.0003	
86,760	600	.0012	.0004	E = 3,125,000 pounds per square inch.
101,220	700	.0016	.0006	
115,680	800	.0019	.0007	
130,140	900	.0022	.0009	
144,600	1,000	.0025	.0010	E = 3,000,000 pounds per square inch.
159,060	1,100	.0029	.0012	
173,520	1,200	.0033	.0013	
187,980	1,300	.0037	.0015	
202,440	1,400	.0040	.0017	
216,900	1,500	.0044	.0018	E = 2,273,000 pounds per square inch.
231,360	1,600	.0047	.0019	
245,820	1,700	.0050	.0020	
260,280	1,800	.0054	.0021	
274,740	1,900	.0057	.0022	
289,200	2,000	.0060	.0023	
375,000	2,590	....	....	Crack.
413,000	2,860	....	....	Ultimate strength.

ADDITIONAL TESTS ON CONCRETE CUBES MADE AT WATERTOWN ARSENAL.

Tests of cubes 4 and 5 years old, continued from Report 1902, page 513. Cubes set in air in a dry, cool building.

Marks.	Brand of cement.	Composition.			Age.		Weight.			Dimensions.			Sectional area.	First crack.	Compressive strength.		Remarks.
		Cement.	Sand.	Broken stone.			Total.		Per cubic foot.	Height.	Compressed surface.				Total.	Per square inch.	
					Yrs.	*Mos.*	*Lbs.*	*Ozs.*	*Lbs.*	*Inches.*	*Ins.*	*Ins.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Lbs.*	
315	Alpha...	1	2	4—1½″ and 2½″ trap	4	0	152	8	151.4	11.99	12.04	12.05	145.08	389,500	403,000	2,780	
316	....	......	......	....	.....	.....	148	0	148.4	11.87	12.07	12.02	145.08	377,208	416,000	2,870	
317	....	......	......	....	.....	.....	149	0	149.3	11.91	12.03	12.04	144.84	408,000	434,000	3,000	
318	....	......	......	....	.....	.....	150	8	150.5	11.94	12.03	12.03	144.72	425,000	442,000	3,050	
319	....	......	......	....	.....	.....	151	8	151.5	11.93	12.03	12.04	144.84	405,000	440,000	3,040	
392	Alpha...	1	2	4—2½″ trap........	4	0	154	0	154.8	11.92	12.02	12.00	144.24	468,000	530,000	3,670	
393	....	......	......	....	.....	.....	151	8	151.7	11.90	12.05	12.04	145.08	377,208	421,000	2,900	
394	....	......	......	....	.....	.....	152	0	152.3	11.93	12.03	12.02	144.60	375,000	413,000	2,860	
395	....	......	......	....	.....	.....	152	0	152.3	11.95	12.01	12.02	144.36	376,000	412,000	2,850	
396	....	......	......	....	.....	.....	152	8	151.6	11.95	12.10	12.02	145.44	345,000	372,000	2,560	
322	Alpha...	1	2	4—1½″ and 2½″ trap	5	2	150	0	149.0	12.00	12.06	12.02	144.96	382,000	403,200	2,780	
326	....	......	......	....	.....	.....	146	12	146.2	11.95	12.05	12.06	145.20	349,000	359,500	2,480	
325	....	......	......	....	5	1	143	8	142.9	11.95	12.05	12.05	145.20	231,000	262,000	1,810	Weighed and tested after heating over wood fire. Loss in weight, 4 pounds, 8 ounces.
401	Alpha...	1	2	4—2½″ trap.......	5	2	158	0	156.6	12.00	12.06	12.05	145.32	330,000	429,800	2,960	
398	....	......	......	....	5	1	116	8	147.1	11.90	12.03	12.02	144.60	303,000	379,000	2,620	Weighed and tested after heating over wood fire. Loss in weight, 4 pounds, 8 ounces,
378	Alpha...	1	2	4—2½″ trap.......	5	4	146	12	145.6	12.02	12.03	12.04	144.84	....	317,000	2,190	Weighed and tested after heating over wood fire. Surface cracks after heating. Loss in weight, 5 pounds, 9 ounces.
379	....	......	......	....	.....	.....	144	0	143.9	11.97	12.01	12.03	144.48	....	358,500	2,480	Weighed and tested after heating over wood fire. Surface cracks after heating. Loss in weight, 5 pounds.
397	....	......	......	....	.....	.....	145	0	145.4	11.83	12.10	12.03	145.56	....	378,200	2,600	Weighed and tested after heating over wood fire. Surface cracks after heating. Loss in weight, 7 pounds.

CINDER CONCRETE CUBES.

Specimens furnished by the Eastern Expanded Metal Company, of Boston, Mass.
Lehigh Portland cement used.
Cubes set in air.
For previous tests see Report of 1903, page 536.

[Proportions of ingredients stated by volume.]

No. of test.	Marks.	Composition.				Age.		Weight.		Dimensions.			Sectional area.	First crack.	Compressive strength.	
		Cement.	Sand.	Cinders.	Water.			Total.	Per cubic foot.	Height.	Compressed surface.				Total.	Per square inch.
						Yrs.	*Mos.*	*Pounds.*	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
1519	6	1	2	4	1⅓	1	3½	114	110.6	12.14	12.12	12.11	146.77	346,000	358,000	2,440
1520	7	1	2	4	1⅓	1	3½	114	110.4	12.18	12.16	12.05	146.53	365,000	365,000	2,490
1521	8	1	2	4	1⅓	1	3½	116½	111.5	12.35	12.13	12.05	146.17	372,000	381,000	2,610
1522	9	1	2	4	1⅓	1	3½	113½	109.7	12.17	12.10	12.15	147.02	317,000	355,000	2,410
1528	6	1	2½	5	1⅔	1	3½	111½	109.1	12.18	12.12	11.96	144.96	272,000	282,000	1,950
1529	7	1	2½	5	1⅔	1	3½	109	107.2	12.26	12.03	11.92	143.40	218,000	234,000	1,630
1530	8	1	2½	5	1⅔	1	3½	108½	105.4	12.28	12.10	11.97	144.84	211,000	214,000	1,480
1531	9	1	2½	5	1⅔	1	3½	108½	106.7	12.22	11.92	12.07	143.87	249,900	249,900	1,740
1537	6	1	3	6	2	1	3½	103	101.3	12.10	12.06	12.05	145.32	203,400	203,400	1,400
1538	7	1	3	6	2	1	3½	105½	101.1	12.35	12.16	12.01	146.04	202,000	202,000	1,380
1539	8	1	3	6	2	1	3½	104½	101.2	12.25	12.06	12.08	145.68	184,000	188,000	1,290
1540	9	1	3	6	2	1	3½	103	102.3	12.23	12.02	12.03	144.60	199,800	199,800	1,380

CEMENT.

MATERIAL FOR LONG TIME TESTS.

Brand and marks.	Composition.		Age, set in air.		Weight.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Cement.	Water.			Total.		Per cubic foot.	Height.	Compressed surface.				Total.	Per square inch.
		Per cent.	*Yrs.*	*Mos.*	*Lbs.*	*Ozs.*	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
Newark & Rosendale, Aug. 24, 1901.	Neat	42.8	1	0	......	......	......	3.96	4.06	4.08	16.56	9,100	22,600	1,360
Do	do	42.8	1	0	......	......	......	4.00	4.01	4.10	16.44	21,800	25,400	1,540
Do	do	42.8	1	0	......	......	......	3.97	4.07	4.05	16.48	21,000	27,650	1,680
Do	do	42.8	1	0	......	......	......	3.99	4.01	4.04	16.20	20,500	26,200	1,620
Do	do	42.8	1	0	......	......	......	3.97	4.03	4.06	16.36	19,800	25,800	1,580
Do	do	42.8	3	1	3	13.5	101.7	4.01	4.07	4.00	16.28	27,200	27,200	1,670
Do	do	42.8	3	1	3	13.0	101.9	4.06	4.02	3.96	15.92	32,700	32,700	2,050
Do	do	42.8	3	1	3	15.5	103.6	4.06	4.07	4.01	16.32	32,800	32,800	2,010
Do	do	42.8	3	1	3	13.0	101.4	4.08	3.95	4.03	15.92	27,500	27,500	1,730
Do	do	42.8	3	1	3	14.5	104.2	4.07	3.95	4.03	15.92	29,800	29,800	1,870
Star, without plaster, Aug. 26, 1901.	do	25.4	1	0	......	......	......	3.97	4.07	4.04	16.44	101,400	101,400	6,170
Do	do	25.4	1	0	......	......	......	3.97	4.04	4.03	16.28	87,000	90,200	5,540
Do	do	25.4	1	0	......	......	......	4.00	3.97	4.04	16.04	89,000	101,100	6,300
Do	do	25.4	1	0	......	......	......	4.00	4.02	4.05	16.28	80,500	82,200	5,050
Do	do	25.4	3	1	4	13.0	128.7	4.05	4.03	3.96	15.96	97,000	102,900	6,450
Do	do	25.4	3	1	4	13.5	128.5	4.02	4.02	4.03	16.20	93,900	93,900	5,800
Do	do	25.4	3	1	4	14.0	130.3	4.06	4.00	3.98	15.92	88,000	88,000	5,530
Do	do	25.4	3	1	4	14.0	129.3	4.02	4.05	4.00	16.20	90,100	90,100	5,560
Do	do	25.4	3	1	4	15.5	130.1	4.05	4.00	4.07	16.28	87,400	90,200	5,540
Star, with plaster, Aug. 26, 1901	do	24.6	1	0	......	......	......	3.98	4.03	4.07	16.40	105,900	105,900	6,460
Do	do	24.6	1	0	......	......	......	3.98	4.04	4.09	16.52	105,500	109,100	6,600
Do	do	24.6	1	0	......	......	......	4.04	3.97	4.06	16.12	99,700	99,700	6,180
Do	do	24.6	1	0	......	......	......	3.98	4.02	3.96	15.92	108,300	108,300	6,800
Do	do	24.6	1	0	......	......	......	3.99	4.02	4.02	16.16	86,000	109,900	6,800
Do	do	24.6	3	1	4	13.0	129.4	4.03	3.97	4.02	15.96	102,500	103,200	6,470
Do	do	24.6	3	1	4	11.5	126.8	4.01	3.98	4.03	16.04	93,700	95,300	5,940
Do	do	24.6	3	1	4	11.5	127.2	4.01	4.03	3.97	16.00	80,600	86,800	5,430
Do	do	24.6	3	1	4	12.5	126.5	4.04	4.06	3.98	16.16	84,000	101,800	6,300
Do	do	24.6	3	1	4	13.0	128.0	4.05	3.98	4.03	16.04	87,000	89,900	5,600

CEMENT—Continued.

MATERIAL FOR LONG TIME TESTS—continued.

Brand and marks.	Composition.		Age, set in air.		Weight.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Cement.	Water.			Total.		Per cubic foot.	Height	Compressed surface.				Total	Per square inch.
		Per cent.	*Yrs.*	*Mos.*	*Lbs.*	*Ozs.*	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
Potomac, Aug. 26, 1901	Neat	50.0	1	0				3.96	4.00	4.00	16.00	7,000	12,100	756
Do	do	50.0	1	0				4.00	3.97	3.98	15.80	7,200	16,600	1,050
Do	do	50.0	1	0				4.00	3.97	3.98	15.80	9,800	16,050	1,020
Do	do	50.0	1	0				3.98	4.02	4.00	16.08	9,000	18,400	1,140
Do	do	50.0	1	0				4.01	3.98	3.97	15.80	8,100	15,200	962
Do	do	50.0	3	1	3	13.0	103.3	3.98	4.02	3.98	16.00		23,400	1,460
Do	do	50.0	3	1	3	12.5	102.2	4.02	4.03	3.95	15.92		19,100	1,200
Do	do	50.0	3	1	3	13.0	103.9	3.99	3.97	4.00	15.88		23,400	1,470
Do	do	50.0	3	1	3	12.0	101.1	4.02	4.01	3.98	15.96		17,900	1,120
Do	do	50.0	3	1	3	14.0	103.9	4.01	4.05	3.97	16.08		21.500	1,340
	(Cubes made from Potomac cement contained cracks before testing.)													
Silica, Aug. 27, 1901	do	29.1	1	0				3.97	4.02	3.99	16.04	49,800	49,800	3,100
Do	do	29.1	1	0				4.00	4.07	4.00	16.28	50,600	50,600	3,110
Do	do	29.1	1	0				3.96	4.04	4.06	16.40	55,600	55,600	3,390
Do	do	29.1	1	0				3.97	4.04	4.07	16.44	57,400	57,400	3,490
Do	do	29.1	1	0				3.97	4.04	4.00	16.16	42,000	46,300	2,870
Do	do	29.1	3	1	4	3.0	113.5	4.00	4.01	3.96	15.96	40,500	44,000	2,760
Do	do	29.1	3	1	4	4.5	114.2	4.01	4.00	4.04	16.16	47,400	47,400	2,930
Do	do	29.1	3	1	4	5.0	115.0	4.03	3.95	4.07	16.08	54,800	54,800	3,410
Do	do	29.1	3	1	4	5.0	115.6	4.02	4.06	3.95	16.04	49,900	49,900	3,110
Do	do	29.1	3	1	4	3.5	113.1	3.98	4.04	4.01	16.20	42,200	42,200	2,600

RETARDED SET SERIES.

Retarded 102 hours.
For earlier tests see Report 1901, pages 509, 511.

Marks.	Brand.	Composition.		Age, set in air.		Weight.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
		Cement.	Original water.			Total.		Per cubic foot.	Height.	Compressed surface.				Total.	Per square inch.
			Per cent.	*Yrs.*	*Mos.*	*Lbs.*	*Ozs.*	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
July 17, 1901—102	Star, with plaster	Neat	32.9	3	2	3	3.0	87.6	3.97	3.94	4.02	15.84	10,600	10,600	670
Do	do	do	32.9	3	2	3	3.0	87.1	3.98	3.93	4.04	15.88	9,200	9,200	580
Do	do	do	32.9	3	2	3	3.5	88.2	3.98	3.94	4.02	15.84	9,800	9,800	620
Do	do	do	32.9	3	2	3	5.0	90.0	4.03	3.95	4.00	15.80	11,400	11,400	720
July 22, 1901—102	Star, without plaster	do	42.0	3	2	3	11.0	99.4	3.99	4.01	4.01	16.08	16,200	16,200	1,010
Do	do	do	42.0	3	2	3	12.0	100.3	3.99	4.05	4.00	16.20	13,800	13,800	850
Do	do	do	42.0	3	2	3	10.5	100.7	3.98	3.99	3.95	15.76	15,900	15,900	1,010
Do	do	do	42.0	3	2	3	11.5	100.8	4.01	3.98	4.00	15.92	15,500	15,500	970
Do	do	do	42.0	3	2	3	11.0	99.7	4.01	3.97	4.02	15.96	16,000	16,000	1,000

CONCRETE AND MORTAR COLUMNS.

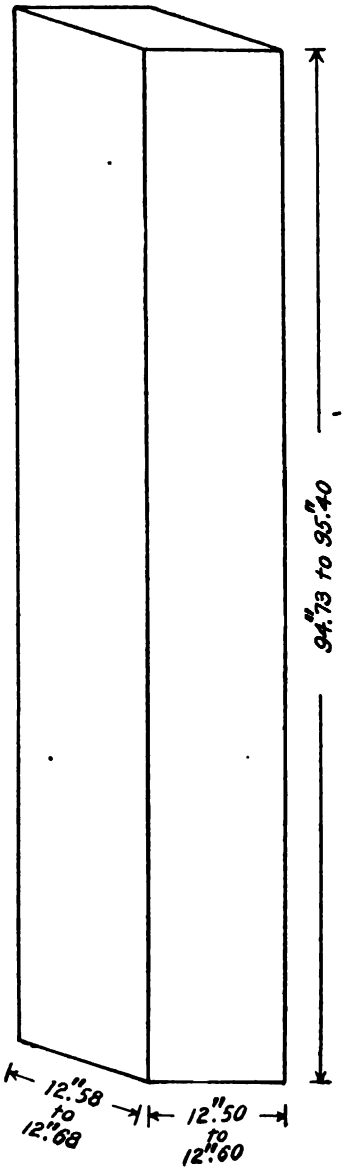
PLAIN AND REËNFORCED WITH LONGITUDINAL STEEL BARS.

REËNFORCING BARS EXTEND FROM END TO END OF THE COLUMNS.

Material, in part, exhibited at the Louisiana Purchase Exposition, St. Louis, Mo., 1904.

CONCRETE COLUMNS.

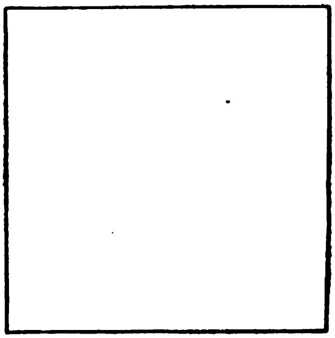
Reënforced and plain.



No. 1618.

CEMENT MORTAR COLUMN.

1:1 Mixture.
Plain column, without reënforcing bars.



Composition, by volume: Vulcanite cement, 1; sand, 1.
Age, set in air, 6 months.
Weight of column, total, 1,192 pounds.
Weight of mortar, 1,192 pounds = 135 pounds per cubic foot.
Height of column, 95.55 inches.
Sectional area of column, gross, 12″.60 × 12″.67 = 159.64 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,964	100	0.	0.	Initial load.
23,946	150	.0007	....	
31,928	200	.0013	.0001	
39,910	250	.0021	....	
47,892	300	.0030	.0001	
55,874	350	.0038	....	
63,856	400	.0048	.0002	
71,838	450	.0056	....	
79,820	500	.0065	.0003	
87,802	550	.0075	....	
95,784	600	.0084	.0004	E (100–600) = 3,125,000 pounds per square inch.
....	200	.0016	....	
....	300	.0034	....	
....	400	.0051	....	
....	500	.0069	....	
....	600	.0085	....	
....	500	.0070	....	
....	400	.0054	....	
....	300	.0036	....	
....	200	.0018	.0003	
103,766	650	.0092	....	
111,748	700	.0103	.0004	
119,730	750	.0110	....	
127,712	800	.0121	.0006	
135,694	850	.0127	....	
143,676	900	.0136	.0007	
151,658	950	.0144	....	
159,640	1,000	.0153	.0007	E (600–1,000) = 3,030,000 pounds per square inch.
....	200	.0020	....	

No. 1618—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
....	300	.0036	....	
....	400	.0056	....	
....	500	.0074	....	
....	600	.0091	....	
....	500	.0075	....	
....	400	.0059	....	
....	300	.0040	....	
....	200	.0021	.0007	
167,622	1,050	.0159	....	
175,604	1,100	.0169	.0008	
183,586	1,150	.0177	....	
191,568	1,200	.0188	.0010	
199,550	1,250	.0195	....	
207,532	1,300	.0204	.0012	
215,514	1,350	.0211	....	
223,496	1,400	.0221	.0014	
231,478	1,450	.0226	....	
239,460	1,500	.0236	.0015	E (1,000-1,500)=3,333,000 pounds per square inch.
....	200	.0028	....	
....	300	.0045	....	
....	400	.0063	....	
....	500	.0083	....	
....	600	.0100	....	
....	500	.0083	....	
....	400	.0066	....	
....	300	.0047	....	
....	200	.0028	.0013	
247,442	1,550	.0241	....	
255,424	1,600	.0251	.0015	
Rested under initial load 3 hours.				
263,406	1,650	.0264	....	
271,388	1,700	.0277	.0027	
279,370	1,750	.0288	....	
287,352	1,800	.0295	.0030	
295,334	1,850	.0304	....	
303,316	1,900	.0313	.0031	
311,298	1,950	.0321	....	
319,280	2,000	.0330	.0032	E (1,500-2,000)=3,247,000 pounds per square inch.
....	200	.0045	....	
....	300	.0063	....	
....	400	.0081	....	
....	500	.0100	....	
....	600	.0119	....	
....	500	.0103	....	
....	400	.0085	....	
....	300	.0065	....	
....	200	.0046	.0032	
....	200	.0044	....	
....	400	.0081	....	
....	600	.0119	....	
....	800	.0150	....	
....	1,000	.0183	....	
....	800	.0154	....	
....	600	.0123	....	
....	400	.0086	....	
....	200	.0048	.0033	
327,262	2,050	.0342	....	
335,244	2,100	.0352	.0039	
343,226	2,150	.0361	....	
351,208	2,200	.0371	.0040	
359,190	2,250	.0378	....	
367,172	2,300	.0388	.0043	
375,154	2,350	.0393	....	
383,136	2,400	.0405	.0043	
391,118	2,450	.0415	....	
399,100	2,500	.0424	.0049	E (2,000-2,500)=3,247,000 pounds per square inch.
....	200	.0064	....	
....	300	.0077	....	
....	400	.0096	....	
....	500	.0116	....	

No. 1618—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
	600	.0134		
	500	.0118		
	400	.0100		
	300	.0079		
	200	.0060	.0044	
	200	.0059		
	400	.0096		
	600	.0131		
	800	.0165		
	1,000	.0196		
	800	.0168		
	600	.0136		
	400	.0100		
	200	.0060	.0044	Micrometer removed.
*605,000	3,790			Upper end of column cracked.
Released to initial load and rested 17 hours, after which the micrometer was reapplied and set at zero under initial load.				
	100	0.		
	200	.0015		
	300	.0033		
	400	.0051		
	500	.0070		
	600	.0090		
	500	.0073		
	400	.0055		
	300	.0037		
	200	.0018	0.	
	200	.0015		
	400	.0053		
	600	.0090		
	800	.0126		
	1,000	.0156		
	1,200	.0188		
	1,400	.0221		
	1,600	.0250		
	1,800	.0280		
	2,000	.0314		
	2,200	.0347		
	2,400	.0380		
	2,600	.0420		
	2,800	.0450		
	3,000	.0483		
	3,200	.0519		
	3,000	.0498		
	2,800	.0473		
	2,600	.0444		
	2,400	.0415		
	2,200	.0388		
	2,000	.0359		
	1,800	.0329		
	1,600	.0297		
	1,400	.0267		
	1,200	.0236		
	1,000	.0204		
	800	.0170		
	600	.0135		
	400	.0095		
	200	.0049	.0030 .0023 .0020	Immediate set. Set after 5 minutes' rest. Set after 25 minutes' rest.
	200	.0035		
	300	.0055		
	400	.0075		
	500	.0094		
	600	.0118		
	500	.0098		
	400	.0086		
	300	.0064		
	200	.0042	.0027	Micrometer removed.

No. 1618—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
800,000	5,011			Maximum load of the testing machine applied without failure of column. An irregular, longitudinal crack 29" long opened at middle of length of column.

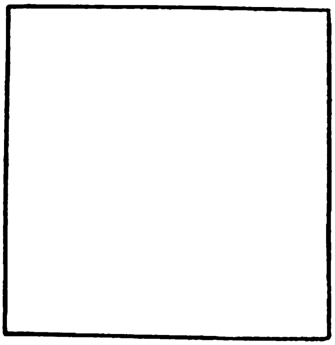
After sustaining total load of 800,000 pounds, the load was reduced to 15,964 pounds total (100 pounds per square inch). The micrometer was again applied on a gauged length of 50", as before, and after the column had rested 30 minutes was reset at zero, and column again loaded.

	100	0.	0.	Micrometer set at zero.
	200	.0014		
	300	.0035		
	400	.0054		
	500	.0073		
	600	.0091		
	500	.0076		
	400	.0059		
	300	.0040		
	200	.0019	.0001	
			−.0005	After resting 40 minutes under initial load.
	200	.0011		
	400	.0050		
	800	.0122		
	1,200	.0180		
	1,600	.0254		
	2,000	.0320		
	2,400	.0390		
	2,800	.0456		
	3,200	.0528		
	3,600	.0598		
	4,000	.0673		
	3,600	.0630		
	3,200	.0575		
	2,800	.0515		
	2,400	.0455		
	2,000	.0391		Immediate recovery.
		.0387		After 5 minutes' rest.
	1,600	.0327		
	1,200	.0259		
	800	.0188		Immediate recovery.
		.0180		After 3 minutes' rest.
	400	.0106		
	200	.0058	.0035	Immediate set.
			.0017	After 10 minutes' rest.
			.0015	After 15 minutes' rest
	200	.0031		
	400	.0070		
	600	.0107		
	800	.0141		
	1,000	.0177		
	800	.0147		
	600	.0114		
	400	.0078		
	200	.0037	.0018	Test discontinued.

No. 1611.

1:1:2 Mixture.

Plain column, without reënforcing bars.



Composition, by volume: Vulcanite cement, 1; sand, 1; pebbles (½" to 1½"), 2. Water, 42.5 per cent of cement, by weight.

Age, set in air, 7 months 28 days.

Weight of column, total, 1,249 pounds.

Weight of concrete, 1,249 pounds = 144.1 pounds per cubic foot.

Height of column, 94.80 inches.

Sectional area of column, gross, 12".56 × 12".58 = 158 square inches.

Gauged length, 50".

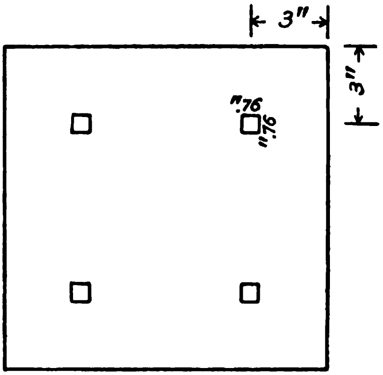
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,800	100	0.	0.	Initial load. Loaded with 20,000 pounds before testing.
23,700	150	.0009		
31,600	200	.0018	.0003	
39,500	250	.0027		
47,400	300	.0036	.0007	
55,300	350	.0046		
63,200	400	.0057	.0011	
71,100	450	.0069		
79,000	500	.0078	.0014	
86,900	550	.0090		
94,800	600	.0101	.0017	E (100-600) = 2,976,000 pounds per square inch.
102,700	650	.0112		
110,600	700	.0124	.0021	
118,500	750	.0135		
126,400	800	.0147	.0026	
134,300	850	.0159		
142,200	900	.0170	.0030	
150,100	950	.0181		
158,000	1,000	.0194	.0034	E (600-1,000) = 2,632,000 pounds per square inch.
165,900	1,050	.0204		
173,800	1,100	.0218	.0039	
181,700	1,150	.0233		
189,600	1,200	.0244	.0044	
197,500	1,250	.0259		
205,400	1,300	.0270	.0052	
213,300	1,350	.0285		
221,200	1,400	.0300	.0060	
229,100	1,450	.0323		
237,000	1,500	.0335	.0075	E (1,000-1,500) = 2,500,000 pounds per square inch.
244,900	1,550	.0349		
252,800	1,600	.0361	.0081	
260,700	1,650	.0382		
268,600	1,700	.0400	.0096	
271,000	1,720			Ultimate strength

Opened oblique cracks 2 feet from upper end of column.

No. 1613.

1:1:2 Mixture.

Reënforced with 4 twisted steel bars, each 95.30 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 1; pebbles (½″ to 1½″), 2. Water, 42.5 per cent of cement, by weight.

Age, set in air, 8 months.

Weight of column, total, 1,300 pounds.

Weight of concrete, 1,239 pounds = 144.1 pounds per cubic foot.

Weight of steel bars, 61 pounds.

Height of column, 95.30 inches.

Sectional area of column, gross, $12''.53 \times 12''.63 = 158.25$ square inches.

Sectional area of steel bars, $''.76 \times ''.76 = \square''.578 \times 4 = 2.31$ square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,825	100	0.	0.	Initial load. Loaded with 15,000 pounds before testing.
23,738	150	.0005		
31,650	200	.0010	.0001	
39,563	250	.0015		
47,475	300	.0021	.0004	
55,388	350	.0032		
63,300	400	.0040	.0010	
71,213	450	.0050		
79,125	500	.0063	.0017	
87,038	550	.0074		
94,950	600	.0087	.0028	E (100–600) = 4,237,000 pounds per square inch.
102,863	650	.0097		
110,775	700	.0109	.0031	
118,688	750	.0117		
126,600	800	.0124	.0037	
134,513	850	.0136		
142,425	900	.0145	.0043	
150,338	950	.0156		
158,250	1,000	.0169	.0050	E (600–1,000) = 3,333,000 pounds per square inch.
166,163	1,050	.0183		
174,075	1,100	.0195	.0054	
181,988	1,150	.0207		
189,900	1,200	.0219	.0058	

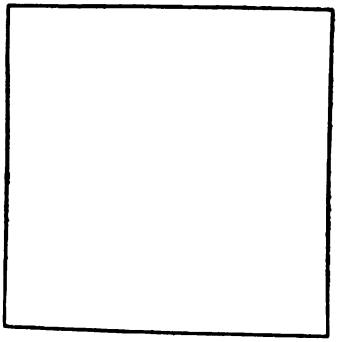
No. 1613—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
197,813	1,250	.0228	....	
205,725	1,300	.0239	.0060	
213,638	1,350	.0251	....	
221,550	1,400	.0261	.0065	
229,463	1,450	.0271	....	
237,375	1,500	.0281	.0068	E (1,000-1,500) = 2,660,000 pounds per square inch.
245,288	1,550	.0292	....	
253,200	1,600	.0303	.0071	
261,113	1,650	.0314	....	
269,025	1,700	.0323	.0075	
276,938	1,750	.0332	....	
284,850	1,800	.0344	.0078	
292,763	1,850	.0359	....	
300,675	1,900	.0370	.0082	
308,588	1,950	.0380	....	
316,500	2,000	.0392	.0086	E (1,500-2,000) = 2,688,000 pounds per square inch. Micrometer removed.
430,000	2,720	....	....	Maximum load applied and released.
....	100	0.	....	Micrometer reapplied and adjusted at zero.
....	500	.0079	....	
....	1,000	.0180	....	
....	1,500	.0271	....	
....	2,000	.0354	....	
....	2,500	.0438	....	
....	2,000	.0382	....	
....	1,500	.0313	....	
....	1,000	.0232	....	
....	500	.0125	....	
....	100	....	.0014	*.0006 set after resting 15 minutes.
....	500	.0090	....	
....	1,000	.0195	....	
....	1,500	.0287	....	
....	1,000	.0216	....	
....	500	.0116	....	
....	100	....	.0013	
....	500	.0096	....	
....	1,000	.0201	....	
....	500	.0111	....	
....	100	....	.0013	
458,000	2,890	....	....	Ultimate strength.

Opened oblique cracks near the upper end of the column.

No. 1609.

1:2:3 Mixture.
Plain column, without reënforcing bars.



Composition, by volume: Vulcanite cement, 1; sand (⅛″ sieve), 2; pebbles (½″ to 1½″ diameter), 3.

Age, set in air, 7 months 25 days.
Weight of column, total, 1,234 pounds.
Weight of concrete, 1,234 pounds = 143.2 pounds per cubic foot.
Height of column, 94.75 inches.
Sectional area of column, 12″.50 × 12″.57 = 157.12 square inches.
Gauged length, 50″.

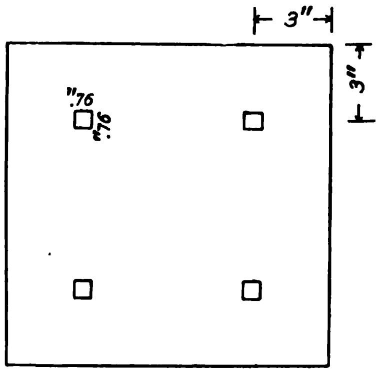
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,712	100	0.	0.	Initial load. Loaded with about 20,000 pounds before testing.
23,568	150	.0007		
31,424	200	.0017	.0006	
39,280	250	.0028		
47,136	300	.0038	.0010	
54,992	350	.0050		
62,848	400	.0063	.0015	
70,704	450	.0075		
78,560	500	.0087	.0019	
86,416	550	.0101		
94,272	600	.0113	.0026	E (100–600) = 2,874,000 pounds per square inch.
102,128	650	.0126		
109,984	700	.0140	.0033	
117,840	750	.0155		
125,698	800	.0170	.0040	
133,552	850	.0182		
141,408	900	.0196	.0049	
149,264	950	.0212		
157,120	1,000	.0229	.0058	E (600–1,000) = 2,381,000 pounds per square inch.
164,976	1,050	.0244		
172,832	1,100	.0259	.0069	
180,688	1,150	.0278		
188,544	1,200	.0293	.0078	
196,400	1,250	.0308		
204,256	1,300	.0328	.0090	
212,112	1,350	.0349		
219,968	1,400	.0364	.0104	
227,824	1,450	.0391		
235,680	1,500	.0409	.0122	E (1,000–1,500) = 2,155,000 pounds per square inch.
243,536	1,550	.0436		
251,392	1,600	.0464	.0150	
278,000	1,769			Ultimate strength.

Opened longitudinal cracks somewhat oblique to axis of column, near upper end.

No. 1612.

1:2:3 Mixture.

Reënforced with 4 twisted steel bars, each 95.30 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles (½″ to 1½″ diameter), 3. Water, 53.1 per cent of cement, by weight.

Age, set in air, 7 months 28 days.

Weight of column, total, 1,301 pounds.

Weight of concrete, 1,240 pounds = 142.2 pounds per cubic foot.

Weight of steel bars, 61 pounds.

Height of column, 95.30 inches.

Sectional area of column, gross, 12″.65 × 12″.68 = 160.40 square inches.

Sectional area of steel bars, ″.76 × ″.76 = ⊔″.578 × 4 = 2.31 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,040	100	0.	0.	Initial load.
24,060	150	.0010	....	
32,080	200	.0025	.0005	
40,100	250	.0038	....	
48,120	300	.0051	.0010	
56,140	350	.0065	....	
64,160	400	.0079	.0015	
72,180	450	.0093	....	
80,200	500	.0106	.0020	
88,220	550	.0120	....	
96,240	600	.0131	.0025	E (100–600) = 2,358,000 pounds per square inch
104,260	650	.0149	....	
112,280	700	.0160	.0031	
120,300	750	.0174	....	
128,320	800	.0187	.0038	
136,340	850	.0202	....	
144,360	900	.0216	.0042	
152,380	950	.0230	....	
160,400	1,000	.0240	.0045	E (600–1,000) = 2,247,000 pounds per square inch
168,420	1,050	.0254	....	
176,440	1,100	.0268	.0049	
184,460	1,150	.0281	....	
192,480	1,200	.0293	.0053	
200,500	1,250	.0306	....	
208,520	1,300	.0317	.0060	

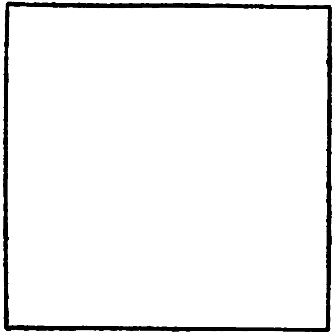
No. 1612—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
216,540	1,350	.0331	....	
224,560	1,400	.0345	.0066	
232,580	1,450	.0363	....	
240,600	1,500	.0375	.0070	E (1,000-1,500)=2,273,000 pounds per square inch.
248,620	1,550	.0390	....	
256,640	1,600	.0408	.0078	
264,660	1,650	.0422	....	
272,680	1,700	.0435	.0081	
280,700	1,750	.0456	....	
288,720	1,800	.0473	.0084	
322,000	2,010	....	....	Ultimate strength.

Opened oblique cracks in upper end of column, and in the vicinity of a porous spot 2 feet from the top.

No. 1583.

1:2:4 Mixture.
Plain column, without reënforcing bars.



Composition, by volume: Vulcanite cement, 1; sand (⅛″ sieve), 2; pebbles (½″ to 1½″ diameter), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 3 months 17 days.

Weight of column, total, 1,284 pounds.

Weight of concrete, 1,284 pounds = 147.6 pounds per cubic foot.

Height of column, 94.73 inches.

Sectional area of column, gross, 12″.66 × 12″.59 = 159.39 square inches.

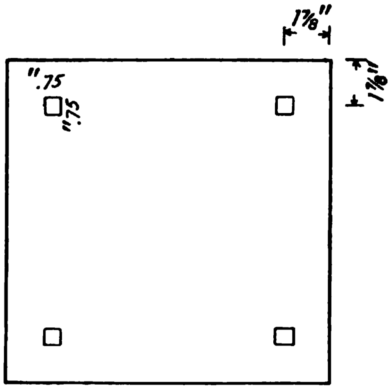
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,939	100	0.	0.	Initial load
23,908	150	.0006	....	
31,878	200	.0013	0.	
39,847	250	.0022	....	
47,817	300	.0030	.0008	
55,786	350	.0039	....	
63,756	400	.0050	.0007	
71,725	450	.0060	....	
79,695	500	.0070	....	
87,664	550	.0080	....	
95,634	600	.0090	.0017	E (100-600) = 3,425,000 pounds per square inch.
103,603	650	.0101	....	
111,573	700	.0112	....	
119,542	750	.0126	....	
127,512	800	.0137	.0030	
135,487	850	.0149	....	
143,451	900	.0162	....	
151,420	950	.0173	....	
159,390	1,000	.0192	.0048	E (600-1,000) = 2,817,000 pounds per square inch.
167,359	1,050	.0205	....	
175,329	1,100	.0218	....	
183,298	1,150	.0232	....	
191,268	1,200	.0246	.0065	
199,237	1,250	.0267	....	
207,207	1,300	.0287	....	
215,176	1,350	.0302	....	
223,146	1,400	.0320	....	
231,116	1,450	.0337	....	
239,085	1,500	.0360	.0110	E (1,000-1,500) = 2,358,000 pounds per square inch.
247,054	1,550	.0401	....	
255,024	1,600	.0425	....	
262,993	1,650	.0457	....	
270,963	1,700	.0478	.0176	
272,000	1,710	....	....	Ultimate strength.

Opened oblique cracks 24″ to 30″ long from lower end of the column.

No. 1580.

1:2:4 Mixture.
Reënforced with 4 twisted steel bars, each 95 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles (½" to 1½" diameter), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 3 months 13 days.

Weight of column, total, 1,288 pounds.

Weight of concrete, 1,227.5 pounds = 143.7 pounds per cubic foot.

Weight of steel bars, 60.5 pounds.

Height of column, 95 inches.

Sectional area of column, gross, 12".60 × 12".51 = 157.62 square inches.

Sectional area of steel bars, ".75 × ".75 = □".563 × 4 = 2.25 square inches.

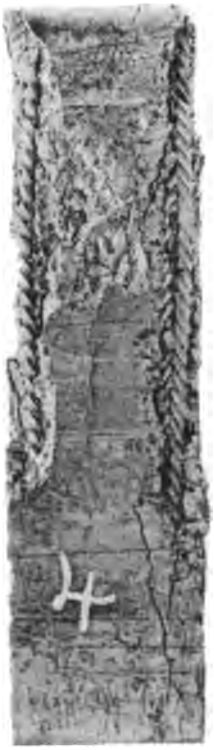
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds*	*Inch.*	*Inch.*	
15,762	100	0.	0.	Initial load.
23,643	150	.0007	....	
31,524	200	.0017	0.	
39,405	250	.0030	....	
47,286	300	.0042	.0004	
55,167	350	.0054	....	
63,048	400	.0066	.0007	
70,929	450	.0078	....	
78,810	500	.0090	.0013	
86,691	550	.0101	....	
94,572	600	.0114	.0017	E (100–600) = 2,577,000 pounds per square inch.
102,453	650	.0126	....	
110,334	700	.0141	.0020	
118,215	750	.0155	....	
126,096	800	.0172	.0028	
133,977	850	.0180	....	
141,858	900	.0191	.0035	
149,739	950	.0206	....	
157,620	1,000	.0216	.0044	E (600–1,000) = 2,667,000 pounds per square inch.
165,501	1,050	.0223	....	
173,382	1,100	.0234	....	
181,263	1,150	.0248	....	
189,144	1,200	.0264	.0054	
197,025	1,250	.0290	....	
204,906	1,300	.0304	....	

No. 1580—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
212,787	1,350	.0320	....	
220,668	1,400	.0338	....	
228,549	1,450	.0357	....	
236,430	1,500	.0380	.0079	E (1,000-1,500)=1,938,000 pounds per square inch.
244,311	1,550	.0420	....	
252,192	1,600	.0439	....	
260,073	1,650	.0458	....	
267,954	1,700	.0483	.0098	
275,835	1,750	.0541	....	
283,716	1,800	.0572	....	
891,597	1,850	.0602	....	
299,478	1,900	.0641	.0130	
307,359	1,950	.0779	....	
313,000	1,990	....	....	Ultimate strength.

Opened longitudinal fractures near upper end of column. Continuing the loads after passing the maximum stress, the steel bars suddenly sprang outward diagonally, splitting off the corners of the column along the upper half of its height.



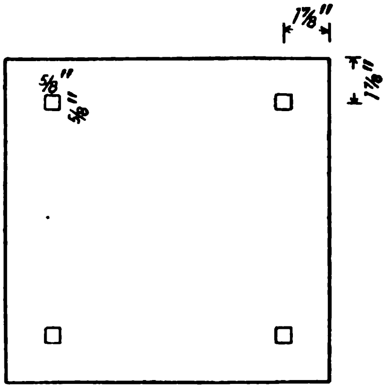
NO. 1580.

CONCRETE COLUMN, 1; 2; 4 MIXTURE, RE-ENFORCED WITH 4-¾ INCH TWISTED STEEL BARS. APPEARANCE AFTER TESTING, SHOWING BUCKLING OF STEEL BARS.

HELIOTYPE CO., BOSTON.

No. 1582.

1:2:4 Mixture.
Reënforced with 4 corrugated steel bars, each 95.3 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles (½" to 1½" diameter), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 3 months 16 days.

Weight of column, total, 1,314 pounds.

Weight of concrete, 1,272.38 pounds = 145.7 pounds per cubic foot.

Weight of steel bars, 41.62 pounds.

Height of column, 95.3 inches.

Sectional area of column, gross, 12".68 × 12".60 = 159.76 square inches.

Maximum sectional area of steel bars, ".64 × ".67 = ".429 × 4 = 1.72 square inches.

Mean sectional area of steel bars, 1.55 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,976	100	0.	0.	Initial load.
23,964	150	.0009	....	
31,952	200	.0018	.0001	
39,940	250	.0026	....	
47,928	300	.0039	.0005	
55,916	350	.0048	....	
63,904	400	.0067	.0019	
71,892	450	.0078	....	
79,880	500	.0089	....	
87,868	550	.0102	....	
95,856	600	.0111	.0027	E (100-600) = 2,976,000 pounds per square inch.
103,844	650	.0123	....	
111,832	700	.0134	....	
119,820	750	.0145	....	
127,808	800	.0158	.0034	
135,796	850	.0171	....	
143,784	900	.0184	....	
151,772	950	.0196	....	
159,760	1,000	.0210	.0046	E (600-1,000) = 2,500,000 pounds per square inch.
167,748	1,050	.0225	....	
175,736	1,100	.0239	....	
183,724	1,150	.0251	....	
191,712	1,200	.0266	.0060	
199,700	1,250	.0281	....	

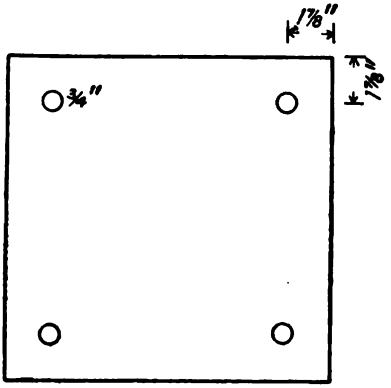
No. 1582—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
207,688	1,300	.0296	....	
215,676	1,350	.0314	....	
223,664	1,400	.0331	....	
231,652	1,450	.0345	....	
239,640	1,500	.0364	.0087	E (1,000-1,500)=2,212,000 pounds per square inch.
247,628	1,550	.0392	....	
255,616	1,600	.0408	....	
263,604	1,650	.0428	....	
271,592	1,700	.0448	.0110	
279,580	1,750	.0473	....	
287,568	1,800	.0501	....	
295,556	1,850	.0530	....	
303,544	1,900	.0551	....	
311,532	1,950	.0584	....	
319,520	2,000	.0614	.0157	E (1,500-2,000)=1,389,000 pounds per square inch.
349,000	2,180	....	....	Ultimate strength.

Opened longitudinal cracks, slightly oblique to axis of column, near the upper end.

No. 1581.

1:2:4 Mixture.
Reënforced with 4 Thacher steel bars, each 95 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles (½" to 1½" diameter), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 3 months 14 days.

Weight of column, total, 1,308 pounds.

Weight of concrete, 1,263.5 pounds = 145.4 pounds per cubic foot.

Weight of steel bars, 44.5 pounds.

Height of column, 95 inches.

Sectional area of column, gross, 12".60 × 12".67 = 159.64 square inches.

Maximum sectional area of steel bars, ".75 diameter = ".442 × 4 = 1.77 square inches.

Mean sectional area of steel bars, 1.65 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,964	100	0.	0.	Initial load.
23,946	150	.0006	....	
31,928	200	.0015	0.	
39,910	250	.0028	....	
47,892	300	.0038	.0004	
55,874	350	.0050	....	
63,856	400	.0060	.0008	
71,838	450	.0073	....	
79,820	500	.0083	....	
87,802	550	.0094	....	
95,784	600	.0107	.0015	E (100-600) = 2,717,000 pounds per square inch.
103,760	650	.0119	....	
111,748	700	.0129	....	
119,730	750	.0140	....	
127,712	800	.0152	.0023	
135,694	850	.0168	....	
143,676	900	.0180	....	
151,658	950	.0194	....	
159,640	1,000	.0208	.0034	E (600-1,000) = 2,439,000 pounds per square inch.
167,622	1,050	.0222	....	
175,604	1,100	.0232	....	
183,586	1,150	.0248	....	
191,568	1,200	.0260	.0048	
199,550	1,250	.0277	....	

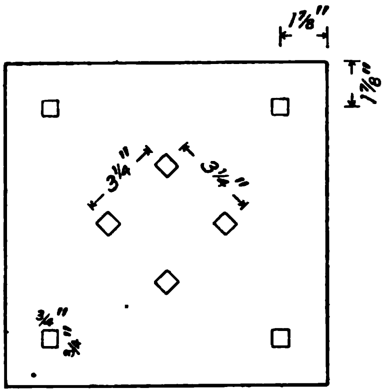
No. 1581—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
207,532	1,300	.0290	....	
215,514	1,350	.0304	....	
223,496	1,400	.0321	....	
231,478	1,450	.0336	....	
239,460	1,500	.0350	.0068	E (1,000-1,500)=2,315,000 pounds per square inch.
247,442	1,550	.0381	....	
255,424	1,600	.0400	....	
263,406	1,650	.0416	....	
271,388	1,700	.0434	.0088	
279,370	1,750	.0471	....	
287,352	1,800	.0496	....	
295,334	1,850	.0518	....	
303,316	1,900	.0550	.0124	
318,000	1,990	....	....	Ultimate strength.

Opened longitudinal cracks near middle of length of column.

No. 1585.

1:2:4 Mixture.
Reënforced with 8 twisted steel bars, each 94.90 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles (½″ to 1½″ diameter), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 3 months 15 days.

Weight of column, total, 1,358 pounds.

Weight of concrete, 1,237 pounds = 143.5 pounds per cubic foot.

Weight of steel bars, 121 pounds.

Height of column, 94.90 inches.

Sectional area of column, gross, 12″.60 × 12″.50 = 157.50 square inches.

Sectional area of steel bars, ″.75 × ″.75 = ″.563 × 8 = 4.50 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,750	100	0.	0.	Initial load.
23,625	150	.0010	....	
31,500	200	.0019	.0002	
39,375	250	.0030	....	
47,250	300	.0039	.0005	
55,125	350	.0049	....	
63,000	400	.0058	.0006	
70,875	450	.0067	....	
78,750	500	.0077	....	
86,625	550	.0087	....	
94,500	600	.0097	.0011	E (100–600) = 2,907,000 pounds per square inch.
102,375	650	.0107	....	
110,250	700	.0115	....	
118,125	750	.0125	....	
126,000	800	.0135	.0017	
133,875	850	.0143	....	
141,750	900	.0157	....	Remained under this load 10 minutes.
149,625	950	.0165	....	
157,500	1,000	.0174	.0020	E (600–1,000) = 2,941,000 pounds per square inch.
165,375	1,050	.0182	....	
173,250	1,100	.0192	....	
181,125	1,150	.0203	....	
189,000	1,200	.0213	.0022	
196,875	1,250	.0228	....	
204,750	1,300	.0238	....	

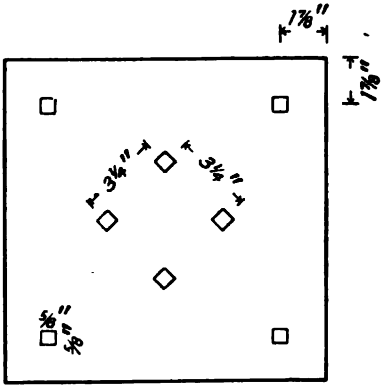
No. 1585—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
212,625	1,350	.0250	....	
220,500	1,400	.0260	....	
228,375	1,450	.0272	....	
236,250	1,500	.0283	.0029	E (1,000-1,500)=2,500,000 pounds per square inch.
244,125	1,550	.0300	....	
252,000	1,600	.0312	....	
259,875	1,650	.0329	....	
267,750	1,700	.0338	....	
275,625	1,750	.0350	....	
283,500	1,800	.0362	....	
291,375	1,850	.0376	....	
299,250	1,900	.0387	....	
307,125	1,950	.0404	....	
315,000	2,000	.0418	.0041	E (1,500-2,000)=2,033,000 pounds per square inch.
322,875	2,050	.0447	....	
330,750	2,100	.0465	....	
338,625	2,150	.0478	....	
346,500	2,200	.0493	....	
354,375	2,250	.0510	....	
362,250	2,300	.0524	....	
370,125	2,350	.0543	....	
378,000	2,400	.0564	....	
385,875	2,450	.0587	....	
393,750	2,500	.0607	.0052	E (2,000-2,500)=1,404,000 pounds per square inch.
401,625	2,550	.0669	....	
409,500	2,600	.0685	....	
417,375	2,650	.0704	....	
425,250	2,700	.0724	....	
433,125	2,750	.0750	....	
441,000	2,800	.0779	.0059	
448,875	2,850	.0852	....	
456,750	2,900	.0890	.0067	
497,000	3,160	....	....	Ultimate strength.

Opened numerous cracks along the length of the column, which took a general longitudinal direction, connected with some irregular transverse cracks. Test was discontinued at a time when the resistance of the column had dropped to 470,000 pounds.

No. 1584.

1:2:4 Mixture.
Reënforced with 8 corrugated steel bars, each 95.4 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles (½" to 1½" diameter), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 3 months 14 days.

Weight of column, total, 1,352 pounds.

Weight of concrete, 1,268.75 pounds = 146.9 pounds per cubic foot.

Weight of steel bars, 83.25 pounds.

Height of column, 95.4 inches.

Sectional area of column, gross, 12".63 × 12".60 = 159.52 square inches.

Maximum sectional area of steel bars, ".64 × ".67 = □".429 × 8 = 3.43 square inches.

Mean sectional area of steel bars, 3.09 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,952	100	0.	0.	Initial load.
23,928	150	.0007	....	
31,904	200	.0015	.0002	
39,880	250	.0023	....	
47,856	300	.0032	.0005	
55,832	350	.0041	....	
63,808	400	.0048	.0007	
71,784	450	.0057	....	
79,760	500	.0066	....	
87,736	550	.0074	....	
95,712	600	.0083	.0011	E (100-600) = 3,472,000 pounds per square inch.
103,688	650	.0091	....	
111,664	700	.0100	....	
119,640	750	.0109	....	
127,616	800	.0117	.0016	
135,512	850	.0127	....	
143,568	900	.0137	....	
151,544	950	.0145	....	
159,520	1,000	.0156	.0022	E (600-1,000) = 3,226,000 pounds per square inch.
167,496	1,050	.0165	....	
175,472	1,100	.0174	....	
183,448	1,150	.0183	....	
191,424	1,200	.0193	.0028	

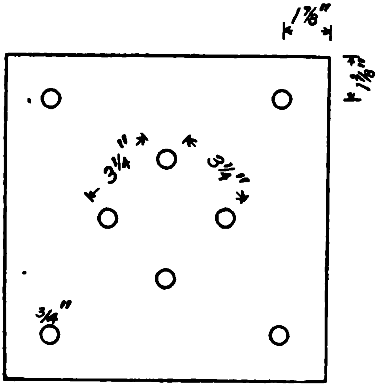
No. 1584—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
199,400	1,250	.0203	....	
207,376	1,300	.8213	....	
215,352	1,350	.0224	....	
223,328	1,400	.0234	....	
231,304	1,450	.0243	....	
239,280	1,500	.0255	.0039	E (1,000-1,500)=3,049,000 pounds per square inch.
247,256	1,550	.0267	....	
255,232	1,600	.0278	....	
263,208	1,650	.0287	....	
271,184	1,700	.0298	.0048	
279,160	1,750	.0314	....	
287,136	1,800	.0324	....	
295,112	1,850	.0337	....	
303,088	1,900	.0347	....	
311,064	1,950	.0360	....	
319,040	2,000	.0376	.0062	E (1,500-2,000)=2,551,000 pounds per square inch.
327,016	2,050	.0391	....	
334,992	2,100	.0404	....	
342,968	2,150	.0415	....	
350,944	2,200	.0427	....	
358,920	2,250	.0440	....	
366,896	2,300	.0457	....	
374,872	2,350	.0476	....	
382,848	2,400	.0486	....	
390,824	2,450	.0505	....	
398,800	2,500	.0522	.0083	E (2,000-2,500)=2,000,000 pounds per square inch.
406,776	2,550	.0567	....	
414,752	2,600	.0586	....	
422,728	2,650	.0601	....	
430,704	2,700	.0623	....	
438,680	2,750	.0640	....	
446,656	2,800	.0671	.0092	
452,000	2,830	....	....	Ultimate strength.

Opened cracks near the upper end of the column. The general direction of the cracks was longitudinal, slightly oblique.

No. 1579.

1:2:4 Mixture.
Reënforced with 8 Thacher steel bars, each 95 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles (½" to 1½" diameter), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 3 months 12 days.

Weight of column, total, 1,338 pounds.

Weight of concrete, 1,249 pounds = 146.4 pounds per cubic foot.

Weight of steel bars, 89 pounds.

Height of column, 95 inches.

Sectional area of column, gross, 12".58 × 12".60 = 158.5 square inches.

Maximum sectional area of steel bars, ".75 diameter = ".442 × 8 = 3.54 square inches.

Mean sectional area of steel bars, 3.31 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,850	100	0.	0.	Initial load.
23,775	150	.0005	....	
31,700	200	.0009	0.	
39,625	250	.0015	....	
47,550	300	.0021	0.	
55,475	350	.0027	....	
63,400	400	.0035	.0001	
71,325	450	.0042	....	
79,250	500	.0049	.0001	
87,175	550	.0058	....	
95,100	600	.0065	.0002	E (100–600) = 3,968,000 pounds per square inch.
103,025	650	.0073	....	
110,950	700	.0081	.0004	
118,875	750	.0088	....	
126,800	800	.0097	.0004	
134,725	850	.0104	....	
142,650	900	.0112	.0005	
150,575	950	.0120	....	
158,500	1,000	.0128	.0006	E (600–1,000) = 3,390,000 pounds per square inch.
166,425	1,050	.0139	....	
174,350	1,100	.0145	.0007	
182,275	1,150	.0156	....	

No. 1579—Continued.

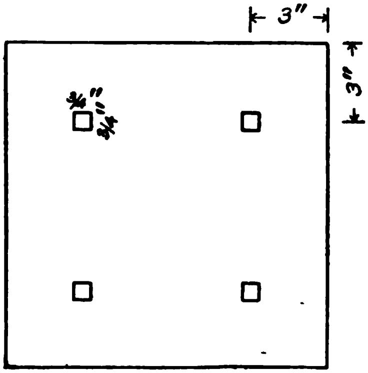
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
190,200	1,200	.0164	.0009	
198,125	1,250	.0173	....	
206,050	1,300	.0181	.0010	
213,975	1,350	.0190	....	
221,900	1,400	.0198	....	
229,825	1,450	.0207	....	
237,750	1,500	.0216	.0013	E (1,000-1,500)=3,086,000 pounds per square inch.
245,675	1,550	.0227	....	
253,600	1,600	.0236	....	
261,525	1,650	.0244	....	
269,450	1,700	.0255	.0016	
277,375	1,750	.0267	....	
285,300	1,800	.0277	....	
293,225	1,850	.0288	....	
301,150	1,900	.0297	.0021	
309,075	1,950	.0310	....	
317,000	2,000	.0320	.0024	E (1,500-2,000)=2,688,000 pounds per square inch.
324,925	2,050	.0332	....	
332,850	2,100	.0343	....	
340,775	2,150	.0354	....	
348,700	2,200	.0364	....	
356,625	2,250	.0373	....	
364,550	2,300	.0386	....	
372,475	2,350	.0398	....	
380,400	2,400	.0411	.0035	
388,325	2,450	.0437	....	
396,250	2,500	.0451	....	
404,175	2,550	.0468	....	
412,100	2,600	.0484	.0047	
420,025	2,650	.0521	....	
427,950	2,700	.0547	....	
435,875	2,750	.0571	....	
438,000	2,760	....	....	Ultimate strength.

Opened longitudinal lines of fracture along middle of length of column.

No. 1610.

1:2:4 Mixture.

Reënforced with 4 twisted steel bars, each 95 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles (½″ to 1½″ diameter), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 7 months 26 days.

Weight of column, total, 1,297 pounds.

Weight of concrete, 1,236 pounds = 143.1 pounds per cubic foot.

Weight of steel bars, 61 pounds.

Height of column, 95 inches.

Sectional area of column, gross, 12″.60 × 12″.65 = 159.39 square inches.

Sectional area of steel bars, ″.76 × ″.76 = ″.578 × 4 = 2.31 square inches.

Gauged length, 50″.

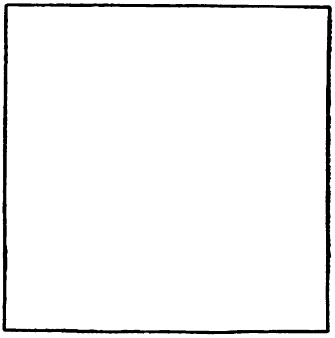
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,939	100	0.	0.	Initial load. Loaded with 20,000 pounds before testing.
23,909	150	.0006	....	
31,878	200	.0015	.0002	
39,848	250	.0022	....	
47,818	300	.0032	.0004	
55,787	350	.0042	....	
63,757	400	.0053	.0007	
71,726	450	.0064	....	
79,696	500	.0074	.0008	
87,666	550	.0086	....	
95,635	600	.0097	.0010	E (100–600) = 2,874,000 pounds per square inch.
103,603	650	.0109	....	
111,574	700	.0119	.0012	
119,544	750	.0133	....	
127,514	800	.0144	.0015	
135,483	850	.0155	....	
143,453	900	.0169	.0019	
151,422	950	.0183	....	
159,392	1,000	.0195	.0023	E (600–1,000) = 2,353,000 pounds per square inch.
167,362	1,050	.0207	....	
175,331	1,100	.0219	.0028	
183,301	1,150	.0232	....	
191,270	1,200	.0246	.0031	
199,240	1,250	.0261	....	
207,210	1,300	.0271	....	
215,179	1,350	.0283	....	
223,149	1,400	.0295	....	
231,118	1,450	.0305	....	
239,088	1,500	.0319	.0042	E (1,000–1,500) = 2,381,000 pounds per square inch.
245,000	1,540	....	....	Cracks opened near bottom end.
289,800	1,820	....	....	Ultimate strength.

Opened longitudinal and oblique cracks near bottom end of column.

No. 1615.

1:2:4 Mixture.

Plain column, without reënforcing bars.



Composition, by volume: Vulcanite cement, 1; sand, 2; trap rock 4. Wet mixture.

Age, set in air, 5 months 10 days.

Weight of column, total, 1,326 pounds.

Weight of concrete, 1,326 pounds = 151.2 pounds per cubic foot.

Height of column, 95.12 inches.

Sectional area of column, gross, 12".62 × 12".62 = 159.26 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,926	100	0.	0.	Initial load. Loaded with 24,000 pounds before testing.
23,889	150	.0004	....	
31,852	200	.0009	0.	
39,815	250	.0016	....	
47,778	300	.0023	.0002	
55,741	350	.0029	....	
63,704	400	.0037	.0004	
71,667	450	.0043	....	
79,630	500	.0052	.0006	
87,593	550	.0060	....	
95,556	600	.0069	.0008	E (100-600) = 4,098,000 pounds per square inch.
....	200	.0018	....	
....	300	.0030	....	
....	400	.0041	....	
....	500	.0055	....	
....	600	.0069	....	
....	500	.0058	....	
....	400	.0045	....	
....	300	.0033	....	
....	200	.0021	.0011	
103,519	650	.0079	....	
111,482	700	.0087	....	
119,445	750	.0095	....	
127,406	800	.0105	.0017	
135,371	850	.0116	....	
143,334	900	.0125	....	
151,297	950	.0134	....	
159,260	1,000	.0145	.0026	E (600-1,000) = 3,448,000 pounds per square inch.

No. 1615—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
....	200	.0036	....	
....	300	.0046	....	
....	400	.0060	....	
....	500	.0074	....	
....	600	.0090	....	
....	500	.0076	....	
....	400	.0064	....	
....	300	.0050	....	
....	200	.0037	.0026	
167,223	1,050	.0159	....	
175,186	1,100	.0169	....	
183,149	1,150	.0180	....	
191,112	1,200	.0191	.0039	
199,075	1,250	.0207	....	
207,038	1,300	.0220	....	
215,001	1,350	.0231	....	
222,964	1,400	.0251	....	
230,927	1,450	.0262	....	
238,890	1,500	.0283	.0075	E (1,000-1,500)=2,809,000 pounds per square inch.
....	200	.0083	....	
....	300	.0097	....	
....	400	.0111	....	
....	500	.0128	....	
....	600	.0142	....	
....	500	.0130	....	
....	400	.0117	....	
....	300	.0102	....	
....	200	.0088	.0073	
246,853	1,550	.0318	....	
254,816	1,600	.0347	.0111	
262,779	1,650	.0387	....	
270,742	1,700	.0416	.0148	
....	200	.0159	....	
....	300	.0174	....	
....	400	.0191	....	
....	500	.0211	....	
....	600	.0229	....	
....	500	.0215	....	
....	400	.0201	....	
....	300	.0185	....	
....	200	.0166	.0148	
278,705	1,750	.0505	.0217	
....	200	.0226	....	
....	300	.0243	....	
....	400	.0264	....	
....	500	.0284	....	
....	600	.0305	....	
....	500	.0291	....	
....	400	.0275	....	
....	300	.0256	....	
....	200	.0237	.0217	
....	200	.0227	....	
....	300	.0237	....	
....	400	.0260	....	
....	500	.0288	....	
....	600	.0310	....	
....	500	.0302	....	
....	400	.0287	....	
....	300	.0275	....	
....	200	.0245	.0223	
278 705	1,750	....	....	Ultimate strength.

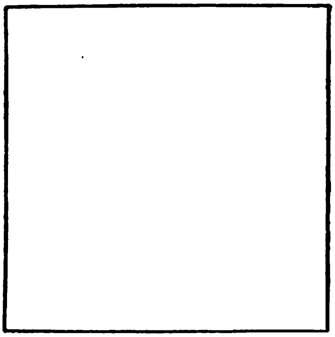
After once sustaining 278,705 pounds and releasing to make the compressive observations under reduced loads, the column failed under 276,000 pounds when the load was again advanced. Cracks opened in the column about 2 to 3 feet from the lower end.

No. 1614.

CINDER CONCRETE COLUMN.

1:2:4 Mixture.

Plain column, without reënforcing bars.



Composition, by volume: Vulcanite cement, 1; sand, 2; cinders, 4. Wet mixture.

Age, set in air, 5 months 16 days.

Weight of column, total 907 pounds.

Weight of concrete, 907 pounds = 103.7 pounds per cubic foot.

Height of column, 94.85 inches.

Sectional area of column, gross, 12″.60 × 12″.65 = 159.39 square inches.

Gauged length, 50″.

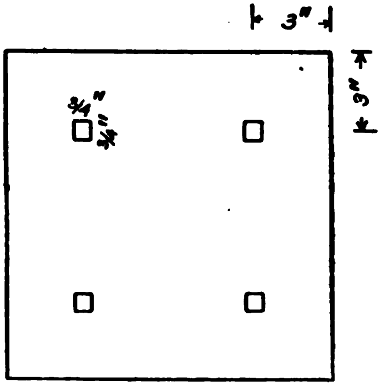
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,939	100	0.	0.	Initial load. Loaded with 21,000 pounds before testing.
23,909	150	.0025	....	
31,878	200	.0052	.0006	
39,848	250	.0082	....	
47,817	300	.0112	.0017	
55,787	350	.0142	....	
63,756	400	.0175	.0028	
71,726	450	.0206	....	
79,695	500	.0239	.0041	
87,665	550	.0274	....	
95,634	600	.0310	.0060	E (100-600) = 1,000,000 pounds per square inch.
....	200	.0112	....	
....	300	.0164	....	
....	400	.0215	....	
....	500	.0264	....	
....	600	.0315	....	
....	500	.0277	....	
....	400	.0233	....	
....	300	.0185	....	
....	200	.0131	.0067	
103,604	650	.0356	....	
111,573	700	.0392	....	
119,543	750	.0438	....	
127,512	800	.0490	.0118	
135,482	850	.0540	....	
138,900	871	....	....	Ultimate strength.

Opened oblique cracks near the upper end of the column.

No. 1616.

CINDER CONCRETE COLUMN.

1:2:4 Mixture.
Reënforced with 4 twisted steel bars, each 96 inches long.



Composition, by volume: Vulcanite cement, 1; sand, 2; cinders, 4. Wet mixture.

Age, set in air, 5 months 16 days.

Weight of column, total, 989 pounds.

Weight of concrete, 928 pounds = 106.3 pounds per cubic foot.

Weight of steel bars, 61 pounds.

Height of column, 96 inches.

Sectional area of column, gross, 12".63 × 12".62 = 159.39 square inches.

Sectional area of steel bars, ".76 × ".76 = □".578 × 4 = 2.31 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,939	100	0.	0.	Initial load. Loaded with 16,000 pounds before testing.
23,909	150	.0014	....	
31,878	200	.0029	0.	
39,848	250	.0043	....	
47,817	300	.0059	.0002	
55,787	350	.0075	....	
63,756	400	.0093	.0005	
71,726	450	.0110	....	
79,695	500	.0127	.0008	
87,665	550	.0143	....	
95,634	600	.0161	.0010	E (100-600) = 1,656,000 pounds per square inch.
....	200	.0036	....	
....	300	.0068	....	
....	400	.0100	....	
....	500	.0131	....	
....	600	.0163	....	
....	500	.0136	....	
....	400	.0106	....	
....	300	.0074	....	
....	200	.0041	.0010	

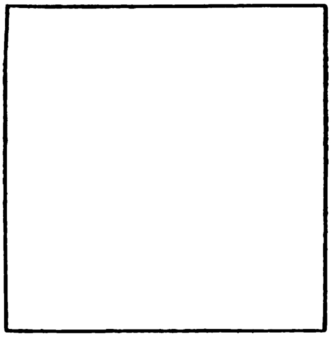
No. 1616—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
103,604	650	.0179	....	
111,573	700	.0195	....	
119,543	750	.0215	....	
127,512	800	.0233	.0016	
135,482	850	.0251	....	
143,451	900	.0270	....	
151,421	950	.0286	....	
159,390	1,000	.0305	.0021	E (600-1,000) = 1,504,000 pounds per square inch.
....	200	.0049	....	
....	300	.0083	....	
....	400	.0118	....	
....	500	.0151	....	
....	600	.0183	....	
....	500	.0154	....	
....	400	.0124	....	
....	300	.0091	....	
....	200	.0054	.0022	
167,360	1,050	.0328	....	
175,329	1,100	.0346	....	
183,299	1,150	.0363	....	
191,268	1,200	.0381	.0029	
199,238	1,250	.0404	....	
207,207	1,300	.0424	.0034	
Rested under 100 pounds per square inch 42 hours.				
....	100	.0019	....	
207,207	1,300	.0415	.0028	
215,177	1,350	.0443	....	
223,146	1,400	.0465	....	
231,116	1,450	.0481	....	
239,085	1,500	.0503	.0041	E (1,000-1,500) = 1,404,000 pounds per square inch.
....	200	.0069	....	
....	300	.0106	....	
....	400	.0144	....	
....	500	.0181	....	
....	600	.0218	....	
....	500	.0187	....	
....	400	.0153	....	
....	300	.0115	....	
....	200	.0076	.0042	
247,055	1,550	.0530	....	
255,024	1,600	.0550	....	
262,994	1,650	.0570	....	
270,963	1,700	.0591	.0053	
278,933	1,750	.0620	....	
286,902	1,800	.0635	.0056	
....	200	.0084	....	
....	300	.0124	....	
....	400	.0165	....	
....	500	.0205	....	
....	600	.0245	....	
....	500	.0211	....	
....	400	.0175	....	
....	300	.0135	....	
....	200	.0091	.0055	
....	600	.0242	.0055	
334,000	2,095	....	....	Ultimate strength.

Failed at the upper end of the column. Opened oblique cracks.

No. 1607.

1:3:6 Mixture.
Plain column, without reënforcing bars.



Composition, by volume: Vulcanite cement,1; sand, 3; pebbles (½" to 1½" diameter), 6. Water, 74.4 per cent of cement, by weight.

Age, set in air, 7 months 23 days

Weight of column, total, 1,232 pounds.

Weight of concrete, 1,232 pounds = 139.8 pounds per cubic foot.

Height of column, 95 inches.

Sectional area of column, gross, 12".63 × 12".69 = 160.27 square inches.

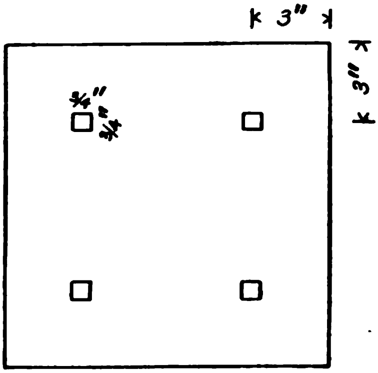
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,027	100	0.	0.	Initial load. Loaded before testing with 28,000 pounds total.
24,041	150	.0015	....	
32,054	200	.0031	.0004	
40,068	250	.0065	....	
48,081	300	.0108	.0045	
56,095	350	.0166	....	
64,108	400	.0235	.0131	E (100-400) = 1,442,000 pounds per square inch.
72,122	450	.0358	....	
74,100	462	....	....	Ultimate strength.

Failed in the upper third of length of column. Opened irregular, longitudinal cracks.

No. 1608.

1 : 3 : 6 Mixture.
Reënforced with 4 twisted steel bars, each 95.25 inches long.



Composition, by volume: Vulcanite cement, 1; sand (⅛″ sieve), 3; pebbles (½″ to 1½″ diameter), 6. Water, 74.4 per cent of cement, by weight.

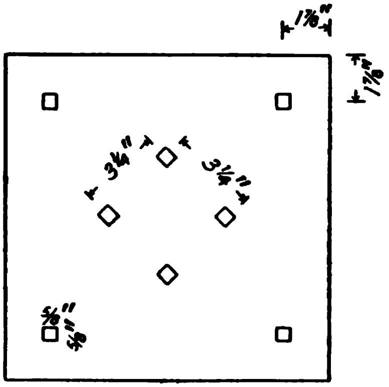
Age, set in air, 7 months 24 days.
Weight of column, total, 1,273 pounds.
Weight of concrete, 1,212 pounds = 139.5 pounds per cubic foot.
Weight of steel bars, 61 pounds.
Height of column, 95.25 inches.
Sectional area of column, gross, 12″.75 × 12.″55 = 160.00 square inches.
Sectional area of steel bars, ″.76 × ″.76 = ″.578 × 4 = 2.31 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,000	100	0.	0.	Initial load.
24,000	150	.0021		
32,000	200	.0047	.0009	
40,000	250	.0071		
48,000	300	.0093	.0019	
56,000	350	.0115		
64,000	400	.0138	.0027	
72,000	450	.0158		
80,000	500	.0179	.0033	
88,000	550	.0200		
96,000	600	.0223	.0038	E (100–600) = 1,351,000 pounds per square inch.
104,000	650	.0248		
112,000	700	.0274	.0044	
120,000	750	.0299		
128,000	800	.0322	.0049	
136,000	850	.0353		
144,000	900	.0380	.0055	
152,000	950	.0414		
160,000	1,000	.0441	.0063	E (600–1,000) = 1,036,000 pounds per square inch.
218,600	1,370			Ultimate strength.

Failed along length of column, 2 feet to 4 feet from upper end. Twisted rods buckled outward.

No. 1617.

1 : 3 : 6 Mixture.
Reënforced with 8 corrugated steel bars, each 95 inches long.
Voids on each of the four sides of the column.



Composition, by volume: Vulcanite cement, 1; sand, 3; trap rock, (½" to 1½"), 6.

Age, set in air, 5 months 10 days.

Weight of column, total, 1,361 pounds.

Weight of concrete, 1,277.75 pounds = 148.8 pounds per cubic foot.

Weight of steel bars, 83.25 pounds.

Height of column, 95 inches.

Sectional area of column, gross, 12".60 × 12".65 = 159.39 square inches.

Maximum sec. area of steel bars, ".64 × ".67 = □".429 × 8 = 3.43 square inches.

Mean sectional area of steel bars, 3.09 square inches.

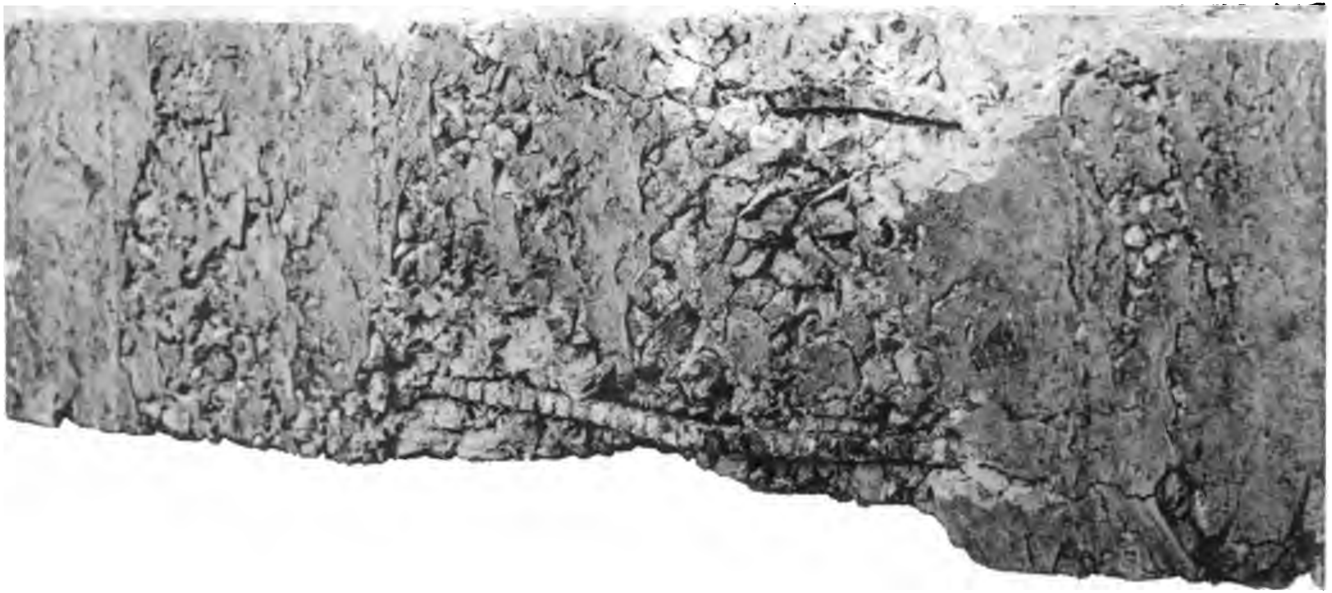
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,939	100	0.	0.	Initial load. Loaded with 28,000 pounds before testing.
23,909	150	.0007	....	
31,878	200	.0013	0.	
39,848	250	.0023	....	
47,817	300	.0031	.0002	
55,787	350	.0040	....	
63,756	400	.0049	.0005	
71,726	450	.0059	....	
79,695	500	.0069	.0006	
87,665	550	.0079	....	
95,634	600	.0090	.0009	E (100-600) =3,086,000 pounds per square inch.
....	200	.0015	....	
....	300	.0039	....	
....	400	.0058	....	
....	500	.0074	....	
....	600	.0091	....	
....	500	.0078	....	
....	400	.0064	....	
....	300	.0045	....	
....	200	.0027	.0011	
103,604	650	.0103	....	
111,573	700	.0113	....	
119,543	750	.0124	....	
127,512	800	.0134	.0015	
135,482	850	.0146	....	

No. 1617—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
143,451	900	.0158	.0019	
151,421	950	.0173	....	
159,390	1,000	.0185	.0023	E (600-1,000) = 2,469,000 pounds per square inch.
....	200	.0038	....	
....	300	.0058	....	
....	400	.0079	....	
....	500	.0098	....	
....	600	.0116	....	
....	500	.0101	....	
....	400	.0083	....	
....	300	.0065	....	
....	200	.0042	.0024	
167,360	1,050	.0200	....	
175,329	1,100	.0212	....	
183,299	1,150	.0224	....	
191,268	1,200	.0239	.0033	
199,238	1,250	.0253	....	
207,207	1,300	.0268	.0037	
217,177	1,350	.028	....	
223,146	1,400	.0300	.0041	
231,116	1,450	.0320	....	
239,085	1,500	.0337	.0048	E (1,000-1,500) = 1,969,000 pounds per square inch.
....	200	.0066	....	
....	300	.0092	....	
....	400	.0119	....	
....	500	.0144	....	
....	600	.0167	....	
....	500	.0149	....	
....	400	.0127	....	
....	300	.0100	....	
....	200	.0072	.0047	
247,055	1,550	.0353	....	
255,024	1,600	.0371	.0049	
Rested 20 hours under initial load.				
....	100	....	.0040	
262,994	1,650	.0391	....	
270,963	1,700	.0409	.0055	
278,938	1,750	.0431	....	
286,902	1,800	.0449	.0062	
294,872	1,850	.0477	....	
302,841	1,900	.0493	.0065	
310,811	1,950	.0521	....	
318,780	2,000	.0540	.0069	E (1,500-2,000) = 1,374,000 pounds per square inch.
....	200	.0091	....	
....	300	.0131	....	
....	400	.0168	....	
....	500	.0202	....	
....	600	.0235	....	
....	500	.0211	....	
....	400	.0181	....	
....	300	.0144	....	
....	200	.0100	.0066	
....	200	.0089	....	
....	400	.0166	....	
....	600	.0230	....	
....	800	.0285	....	
....	1,000	.0337	....	
....	800	.0300	....	
....	600	.0250	....	
....	400	.0187	....	
....	200	.0100	.0066	
365,000	2,290	....	....	Ultimate strength.

Opened longitudinal cracks 3 feet from the upper end. The sustaining power of the column gradually fell and the test was discontinued when the load was reduced to 200,000 pounds resistance. The steel bars were buckled outward, locally, about 3 to 4 feet from upper end of column.



NO. 1617.

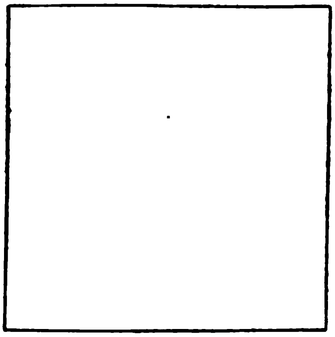
CONCRETE COLUMN, 1; 3; 6 MIXTURE, RE-ENFORCED WITH 8-¼ INCH CORRUGATED STEEL BARS. APPEARANCE AFTER TESTING, SHOWING BUCKLING OF STEEL BARS.

HELIOTYPE CO., BOSTON

No. 1639.

1 : 3 : 6 Mixture.

Plain column, without reënforcing bars.



Composition, by volume: Atlas cement, 1; sand ($\frac{1}{10}''$ screen), 3; trap rock, ($\frac{1}{2}''$ to $1\frac{1}{2}''$), 6. Water, 57.6 per cent of cement, by weight.

Age, set in air, 7 days.

Weight of column, total, 1,363 pounds.

Weight of concrete, 1,363 pounds = 155.4 pounds per cubic foot.

Height of column, 94.90 inches.

Sectional area of column, gross, 12".75 × 12".52 = 159.63 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,963	100	0.	0.	Initial load.
23,945	150	.0009	....	
31,926	200	.0021	.0004	
39,908	250	.0036	....	
47,889	300	.0063	.0023	
55,871	350	.0095	....	
63,852	400	.0155	.0087	
71,834	450	.0290	.0200	
75,000	470	.0565	.0475	
75,200	471	.0980	.0896	Maximum load applied. E (100–471) = 2,208,000 pounds per square inch.

Longitudinal cracks opened. The maximum load applied was apparently the ultimate strength of the column, at the present time.

Test discontinued and column set aside in reserve for an additional test at a later date.

No. 1639.

SUPPLEMENTARY TEST.

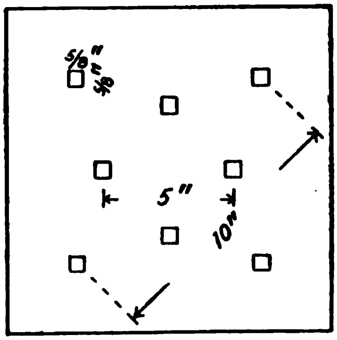
Test resumed after a period of rest of four months.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,963	100	0.	0.	Micrometer reset at zero on original gauged length.
23,945	150	.0015	.0005	
31,926	200	.0029	.0011	
39,908	250	.0042	.0015	
47,889	300	.0055	.0019	
55,871	350	.0071	.0024	
63,852	400	.0087	.0030	
71,834	450	.0101	.0034	
79,815	500	.0116	.0038	
87,796	550	.0131	.0044	
95,778	600	.0146	.0049	E (100-600)=2,577,000 pounds per square inch.
103,759	650	.0161	.0055	
111,741	700	.0178	.0060	
119,722	750	.0196	.0067	
127,704	800	.0214	.0077	
135,685	850	.0231	.0083	
143,667	900	.0251	.0090	
151,648	950	.0269	.0100	
159,630	1,000	.0286	.0107	E (600-1,000)=2.439 000 pounds per square inch.
167,611	1,050	.0309	.0118	
175,593	1,100	.0335	.0131	
183,574	1,150	.0365	.0147	
191,556	1,200	.0391	.0161 .0157	Immediate set. Set after one hour's rest.
....	200	.0180	....	
....	300	.0205	....	
....	400	.0230	....	
....	500	.0354	....	
....	600	.0375	....	
....	500	.0359	....	
....	400	.0240	....	
....	300	.0219	....	
....	200	.0191	.0163	
215,000	1,350	....	....	Ultimate strength.

Opened additional longitudinal cracks, and cracks obliquely and irregularly across the column, near the middle of its height.

No. 1640.

1 : 3 : 6 Mixture.
Reënforced with 8 corrugated steel bars, each 94.89 inches long.



Composition, by volume: Atlas cement, 1; sand ($\frac{1}{10}$″ screen), 3; trap rock (½″ to 1½″), 6. Water, 57.6 per cent of cement, by weight.

Age, set in air, 7 days.

Weight of column, total, 1,412 pounds.

Weight of concrete, 1,328.75 pounds = 154 pounds per cubic foot.

Weight of steel bars, 83.25 pounds.

Height of column, 94.89 inches.

Sectional area of column, gross, 12″.63 × 12″.69 = 160.27 square inches.

Maximum sectional area of steel bars, ″.64 × ″.67 = □″.429 × 8 = 3.43 square inches.

Mean sectional area of steel bars, 3.09 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,027	100	0.	0.	Initial load.
24,041	150	.0009		
32,054	200	.0020	.0005	
40,068	250	.0031		
48,081	300	.0045	.0013	
56,095	350	.0061		
64,108	400	.0079	.0025	
72,122	450	.0100		
80,135	500	.0121	.0041	
88,149	550	.0144		
96,162	600	.0168	.0056	E (100-600) = 2 232,000 pounds per square inch.
104,176	650	.0200		
112,189	700	.0224	.0075	
120,203	750	.0264		
128,216	800	.0295	.0094	
136,230	850	.0335		
144,243	900	.0365	.0112 .0110	Immediate set. Set after 5 minutes' rest.
152,257	950	.0408		
160,270	1,000	.0441	.0126	E (600-1,000) = 985,000 pounds per square inch
168,284	1,050	.0487		
176,297	1,100	.0527	.0139 .0135	Immediate set. Set after 5 minutes' rest.
184,311	1,150	.0579		
192,324	1,200	.0612	.0147 .0143	Immediate set. Set after 5 minutes' rest. } Maximum load applied.

No. 1640—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
....	200	.0199	....	
....	300	.0265	....	
....	400	.0324	....	
....	500	.0378	....	
....	600	.0424	....	
....	500	.0396	....	
....	400	.0355	....	
....	300	.0295	....	
....	200	.0223	.0150 .0144	Immediate set. Set after 2 hours' rest.
....	200	.0196	....	
....	300	.0261	....	
....	400	.0319	....	
....	500	.0370	....	
....	600	.0416	....	
....	500	.0386	....	
....	400	.0346	....	
....	300	.0289	....	
....	200	.0219	.0148	Test discontinued.

Ultimate strength not determined. Column removed from testing machine and held in reserve for subsequent examination.

No. 1640.

SUPPLEMENTARY TEST.

Test resumed after a period of rest of four months.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,027	100	0.	0.	Micrometer reset at zero on original gauged length.
24,041	150	.0029	.0013	
32,054	200	.0058	.0016	
40,068	250	.0086	.0018	
48,081	300	.0118	.0026	
64,108	400	.0161	.0027	
80,135	500	.0211	.0030	
96,162	600	.0254	.0034	E (100-600) = 1,136,000 pounds per square inch.
112,189	700	.0296	.0036	
128,216	800	.0334	.0038	
144,243	900	.0370	.0040	
160,270	1,000	.0405	.0043	E (600-1,000) = 1,408,000 pounds per square inch.
176,297	1,100	.0436	.0044	
192,324	1,200	.0467	.0045	
....	200	.0096	....	
....	300	.0176	....	
....	400	.0232	....	
....	500	.0280	....	
....	600	.0319	....	
....	500	.0289	....	
....	400	.0245	....	
....	300	.0186	....	
....	200	.0114	.0046	
192,324	1,200	.0471	....	
200,338	1,250	.0481	....	
208,351	1,300	.0495	.0047	
224,378	1,400	.0524	.0047	
240,405	1,500	.0551	.0048	E (1,000-1,500) = 1,773,000 pounds per square inch.
256,432	1,600	.0581	.0051	
272,459	1,700	.0612	.0055	
288,486	1,800	.0641	.0058	
304,513	1,900	.0671	.0060	
320,540	2,000	.0704	.0061	E (1,500-2,000) = 1,786,000 pounds per square inch.
336,567	2,100	.0738	.0066	
352,594	2,200	.0777	.0074	
368,621	2,300	.0824	.0089	
384,648	2,400	.0880	.0114	
400,675	2,500	.0948	.0157	E (2,000-2,500) = 1,689,000 pounds per square inch.
416,702	2,600	.1075	.0260	
....	200	.0320	....	
....	300	.0396	....	
....	400	.0463	....	
....	500	.0521	....	
....	600	.0574	....	
....	500	.0536	....	
....	400	.0480	....	
....	300	.0410	....	
....	200	.0330	.0259	
425,000	2,650	....	....	Ultimate strength.

Opened cracks along middle of height.

TABULATION OF COMPRESSIVE STRENGTH OF CONCRETE AND MORTAR COLUMNS, PLAIN AND REËNFORCED WITH LONGITUDINAL STEEL BARS.

Nominal dimensions, 12" by 12" square by 8 feet high.

No. of test.	Brand of cement.	Composition.				Age.		Reënforcing bars.		Sectional areas, square inches.			Weight of concrete per cubic foot.	Compressive strength.		Remarks.
		Cement.	Sand.	Stone or cinder.	Kind of stone or cinder.	Months.	Days.	Number and kind.	Per cent of metal in column.	Gross.	Concrete.	Bars.		Total.	Per square inch on gross area.	
													Pounds	*Pounds.*	*Pounds*	
1618	Vulcanite..	1	1	......	....	6	....	None..........	......	159.64	......	......	135.0	800,000	5,011	Ultimate strength not ascertained. Maximum load of testing machine applied without rupturing the column.
1611	.....do.....	1	1	2	½" to 1½" pebbles..	7	28	None..........	......	158.00	......	......	144.1	271,000	1,720	
1613	.....do.....	1	1	2	.....do..........	8	....	4—¾" twisted...	1.46	158.25	155.94	2.31	144.1	458,000	2,890	
1609	Vulcanite..	1	2	3	½" to 1½" pebbles..	7	25	None..........	......	157.12	......	......	143.2	278,000	1,769	
1612	.....do.....	1	2	3	.....do..........	7	28	4—¾" twisted...	1.44	160.40	158.09	2.31	142.2	322,000	2,010	
1583	Vulcanite..	1	2	4	½" to 1½" pebbles..	3	17	None..........	......	159.39	......	......	147.6	272,000	1,710	
1580	.....do.....	1	2	4	.....do..........	3	13	4—¾" twisted...	1.43	157.62	155.37	2.25	143.7	313,000	1,990	
1582	.....do.....	1	2	4	.....do..........	3	16	4—⅝" corrugated	.97	159.76	158.21	1.55	145.7	349,000	2,180	
1581	.....do.....	1	2	4	.....do..........	3	14	4—⅝" Thacher...	1.03	159.64	157.99	1.65	145.4	318,000	1,990	
1585	Vulcanite..	1	2	4	½" to 1½" pebbles..	3	15	8—¾" twisted...	2.86	157.50	153.00	4.50	143.5	497,000	3,160	
1584	.....do.....	1	2	4	.....do..........	3	14	8—⅝" corrugated	1.94	159.52	156.43	3.09	146.9	452,000	2,830	
1579	.....do.....	1	2	4	.....do..........	3	12	8—⅝" Thacher...	2.09	158.50	155.19	3.31	146.4	438,000	2,760	
1610	Vulcanite..	1	2	4	½" to 1½" pebbles..	7	26	4—¾" twisted...	1.45	159.39	157.08	2.31	143.1	289,800	1,820	
1615	Vulcanite..	1	2	4	½" to 1½" trap rock.	5	10	None..........	......	159.26	......	......	151.2	278,705	1,750	
1614	Vulcanite..	1	2	4	Cinders..........	5	16	None..........	......	159.39	......	......	103.7	138,900	871	
1616	.....do.....	1	2	4	.....do..........	5	16	4—¾" twisted...	1.45	159.39	157.08	2.31	106.3	334,000	2,095	
1607	Vulcanite..	1	3	6	½" to 1½" pebbles..	7	23	None..........	......	160.27	......	......	139.8	74,100	462	
1608	.....do.....	1	3	6	.....do..........	7	24	4—¾" twisted...	1.44	160.00	157.69	2.31	139.5	218,600	1,370	
1617	Vulcanite..	1	3	6	½" to 1½" trap rock.	5	10	8—⅝" corrugated	1.94	159.39	156.30	3.09	148.8	365,000	2,290	

1639	Atlas......	1	3	6	½″ to 1½″ trap rock.	....	7	None............	....	159.63	....	......	155.4	75,200	471	
1639	....	......	....	......	....	....	....	....	....	....	....	......	....	215,000	1,350	After rest of 4 months.
1640	Atlas......	1	3	6	½″ to 1½″ trap rock.	....	7	8—[illegible]″corrugated	1.93	160.27	157.18	3.09	154.0	192,324	1,200	Ultimate strength not ascertained. Reserved for subsequent test.
1640	....	......	....	......	....	....	....	....	....	....	....	......	....	425,000	2,650	After rest of 4 months.

DEDUCED RESULTS ON REËNFORCED COLUMNS.

The following tables are deduced from the details of the tests and show approximately the loads sustained by the concrete and by the steel reënforcing bars for columns of different mixtures, with different amounts of reënforcing metal and under different loads.

The figures in the first five columns of each table are taken from the details of the tests. The loads in pounds per square inch of the second column refer to the gross sectional area of the concrete and steel taken together.

The stresses on the bars shown in the sixth and seventh columns of the tables are computed from the resiliences on the gauged lengths, using a modulus of elasticity of 30,000,000 pounds per square inch for the steel. For example, the stress per square inch on the bars at 200 pounds per square inch on the gross sectional area of column No. 1613 is found to be (30,000,000×″.0009)÷50=540 pounds, which, multiplied by the sectional area of the bars, 2.31, gives the total load on them, 1,247 pounds.

The figures in the eighth column, as indicated by the heading, are the differences between total loads on the column and those on the bars.

The several successive increments of load on the concrete appear in the next column.

In the tenth and eleventh columns are shown the relative loads on the concrete and the bars expressed in percentages, and are the same relations which exist between the figures in the eighth and seventh columns.

The stresses per square inch on the concrete of the twelfth column are the quotients obtained from the figures of the eighth column divided by the net sectional area of the concrete. The ratios of stresses per square inch of the bars to the concrete are shown in the last column of each table.

In the computation of the stresses per square inch on the reënforcing bars, and on which the figures of the tables in part rest, no account is taken of the effect of the initial load on the column.

CONCRETE COLUMN No. 1613.

1:1:2 Mixture. Pebbles. Reënforced with 4—¾″ twisted bars. Age, 8 months.

Sectional area of column, gross, 158.25 square inches; net, 155.94 square inches.

Sectional area of steel bars, 2.31 square inches.

Applied loads.		On 50″ gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Pounds*	*Pounds*	*Pounds.*	*Pounds*			*Lbs.*	
15,825	100	0.	0.	0.								
31,650	200	.0010	.0001	.0009	540	1,247	30,403		96.1	3.9	195	2.8
47,475	300	.0021	.0004	.0017	1,020	2,356	45,119	14,716	95.0	5.0	289	3.5
63,300	400	.0040	.0010	.0030	1,800	4,158	59,142	14,023	93.4	6.6	379	4.7
79,125	500	.0063	.0017	.0046	2,760	6,376	72,749	13,607	91.9	8.1	467	5.9
94,950	600	.0087	.0028	.0059	3,540	8,177	86,773	14,024	91.4	8.6	556	6.4
110,775	700	.0109	.0031	.0078	4,680	10,811	99,964	13,191	90.2	9.8	641	7.3
126,600	800	.0124	.0037	.0087	5,220	12,058	114,542	14,578	90.5	9.5	735	7.1
142,425	900	.0145	.0043	.0102	6,120	14,137	128,288	13,746	90.1	9.9	823	7.4
158,250	1,000	.0169	.0050	.0119	7,140	16,493	141,757	13,469	89.6	10.4	909	7.9
174,075	1,100	.0195	.0054	.0141	8,460	19,543	154,532	12,775	88.8	11.2	991	8.5
189,900	1,200	.0219	.0058	.0161	9,660	22,315	167,585	13,053	88.2	11.8	1,075	9.0
205,725	1,300	.0239	.0060	.0179	10,740	24,809	180,916	13,331	87.9	12.1	1,160	9.3
221,550	1,400	.0261	.0065	.0196	11,760	27,166	194,384	13,468	87.7	12.3	1,247	9.4
237,375	1,500	.0281	.0068	.0213	12,780	29,522	207,853	13,469	87.6	12.4	1,333	9.6
253,200	1,600	.0303	.0071	.0232	13,920	32,155	221,045	13,192	87.3	12.7	1,418	9.8
269,025	1,700	.0323	.0075	.0248	14,880	34,373	234,652	13,607	87.2	12.8	1,505	9.9
284,850	1,800	.0344	.0078	.0266	15,960	36,868	247,982	13,330	87.1	12.9	1,590	10.0
300,675	1,900	.0370	.0082	.0288	17,280	39,917	260,758	12,776	86.7	13.3	1,672	10.3
316,500	2,000	.0392	.0086	.0306	18,360	42,412	274,088	13,330	86.6	13.4	1,758	10.4
430,000	2,720											
458,000	2,890	Ultimate strength.										

CONCRETE COLUMN No. 1612.

1:2:3 Mixture. Pebbles. Reënforced with 4—¾″ twisted bars. Age, 7 months 28 days.

Sectional area of column, gross, 160.40 square inches; net, 158.09 square inches.

Sectional area of steel bars, 2.31 square inches.

Applied loads.		On 50″ gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Pounds*	*Pounds*	*Pounds.*	*Pounds*			*Lbs.*	
16,040	100	0.	0.	0.								
32,080	200	.0025	.0005	.0020	1,200	2,772	29,308		91.4	8.6	185	6.5
48,120	300	.0051	.0010	.0041	2,460	5,683	42,437	13,129	88.2	11.8	268	9.2
64,160	400	.0079	.0015	.0064	3,840	8,870	55,290	12,853	86.2	13.8	350	11.0
80,200	500	.0106	.0020	.0086	5,160	11,920	68,280	12,990	85.1	14.9	432	11.9
96,240	600	.0131	.0025	.0106	6,360	14,692	81,548	13,268	84.7	15.3	516	12.3
112,280	700	.0160	.0031	.0129	7,740	17,879	94,401	12,853	84.1	15.9	597	13.0
128,320	800	.0187	.0038	.0149	8,940	20,651	107,669	13,268	83.9	16.1	681	13.1
144,360	900	.0216	.0042	.0174	10,440	24,116	120,244	12,575	83.3	16.7	760	13.7
160,400	1,000	.0240	.0045	.0195	11,700	27,027	133,373	13,129	83.2	16.8	844	13.9
176,440	1,100	.0268	.0049	.0219	13,140	30,353	146,087	12,714	82.8	17.2	924	14.2
192,480	1,200	.0293	.0053	.0240	14,400	33,264	159,216	13,129	82.7	17.3	1,007	14.3
208,520	1,300	.0317	.0060	.0257	15,420	35,620	172,900	13,684	82.9	17.1	1,094	14.1
224,560	1,400	.0345	.0066	.0279	16,740	38,669	185,891	12,991	82.8	17.2	1,176	14.2
240,600	1,500	.0375	.0070	.0305	18,300	42,273	198,327	12,436	82.4	17.6	1,255	14.6
256,640	1,600	.0408	.0078	.0330	19,800	45,738	210,902	12,575	82.2	17.8	1,334	14.8
272,680	1,700	.0435	.0081	.0354	21,240	49,064	223,616	12,714	82.0	18.0	1,414	15.0
288,720	1,800	.0473	.0084	.0389	23,340	53,915	234,805	11,189	81.3	18.7	1,485	15.7
322,000	2,010	Ultimate strength.										

CONCRETE COLUMN No. 1580.

1:2:4 Mixture. Pebbles. Reënforced with 4—¾″ twisted bars. Age, 3 months 13 days.

Sectional area of column, gross, 157.62 square inches; net, 155.37 square inches.

Sectional area of steel bars, 2.25 square inches.

Applied loads.		On 50″ gauged length.			Computed. stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Pounds*	*Pounds*	*Pounds.*	*Pounds*			*Lbs.*	
15,762	100	0.	0.	0.	....	....	....	....	....	....	....	....
31,524	200	.0017	0.	.0017	1,020	2,295	29,229	....	92.7	7.3	188	5.4
47,286	300	.0042	.0004	.0038	2,280	5,130	42,156	12,927	89.2	10.8	271	8.4
63,048	400	.0066	.0007	.0059	3,540	7,965	55,083	12,927	87.4	12.6	355	10.0
78,810	500	.0090	.0013	.0077	4,620	10,395	68,415	13,332	86.8	13.2	440	10.5
94,572	600	.0114	.0017	.0097	5,820	13,095	81,477	13,062	86.2	13.8	524	11.1
110,334	700	.0141	.0020	.0121	7,260	16,335	93,999	12,522	85.2	14.8	605	12.0
126,096	800	.0172	.0028	.0144	8,640	19,440	106,656	12,657	84.6	15.4	686	12.6
141,858	900	.0191	.0035	.0156	9,360	21,060	120,798	14,142	85.2	14.8	777	12.0
157,620	1,000	.0216	.0044	.0172	10,320	23,220	134,400	13,602	85.3	14.7	865	11.9
189,144	1,200	.0264	.0054	.0210	12,600	28,350	160,794	26,394	85.0	15.0	1,035	12.2
236,430	1,500	.0380	.0079	.0301	18,060	40,635	195,795	35,001	82.8	17.2	1,260	14.3
267,954	1,700	.0483	.0098	.0385	23,100	51,975	215,979	20,184	80.6	19.4	1,390	16.6
299,478	1,900	.0641	.0130	.0511	30,660	68,985	230,493	14,514	77.0	23.0	1,484	20.7
313,000	1,990	Ultimate strength.										

CONCRETE COLUMN No. 1582.

1:2:4 Mixture. Pebbles. Reënforced with 4—⅝″ corrugated bars. Age, 3 months 16 days.

Sectional area of column, gross, 159.76 square inches; net, 158.21 square inches.

Sectional area of steel bars, mean, 1.55 square inches.

Applied loads.		On 50″ gauged length.			Computed. stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Pounds*	*Pounds*	*Pounds.*	*Pounds*			*Lbs.*	
15,976	100	0.	0.	0.	....	....	....	....	....	....	....	....
31,952	200	.0018	.0001	.0017	1,020	1,581	30,371	....	95.1	4.9	192	5.3
47,928	300	.0039	.0005	.0034	2,040	3,162	44,766	14,395	93.4	6.6	283	7.2
63,904	400	.0067	.0019	.0048	2,880	4,464	59,440	14,674	93.0	7.0	376	7.7
95,856	600	.0111	.0027	.0084	5,040	7,812	88,044	28,604	91.9	8.1	557	9.0
127,808	800	.0158	.0034	.0124	7,440	11,532	116,276	28,232	91.0	9.0	735	10.1
159,760	1,000	.0210	.0046	.0164	9,840	15,252	144,508	28,232	90.5	9.5	913	10.8
191,712	1,200	.0266	.0060	.0206	12,360	19,158	172,554	28,046	90.0	10.0	1,090	11.3
239,640	1,500	.0364	.0087	.0277	16,620	25,761	213,879	41,325	89.3	10.7	1,352	12.3
271,592	1,700	.0448	.0110	.0338	20,280	31,434	240,158	26,279	88.4	11.6	1,518	13.4
319,520	2,000	.0614	.0157	.0457	27,420	42,501	277,019	36,861	86.7	13.3	1,751	15.7
349,000	2,180	Ultimate strength.										

CONCRETE COLUMN No. 1581.

1: 2: 4 Mixture. Pebbles. Reënforced with 4—¾″ Thacher bars. Age, 3 months 14 days.

Sectional area of column, gross, 159.64 square inches; net, 157.99 square inches.

Sectional area of steel bars, mean, 1.65 square inches.

Applied loads.		On 50″ gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Pounds*	*Pounds*	*Pounds.*	*Pounds*			*Lbs.*	
15,964	100	0.	0.	0.								
31,928	200	.0015	0.	.0015	900	1,485	30,443	....	95.3	4.7	193	4.7
47,892	300	.0038	.0004	.0034	2,040	3,366	44,526	14,083	93.0	7.0	282	7.2
63,856	400	.0060	.0008	.0052	3,120	5,148	58,708	14,182	91.9	8.1	372	8.4
95,784	600	.0107	.0015	.0092	5,520	9,108	86,676	27,968	90.5	9.5	549	10.1
127,712	800	.0152	.0023	.0129	7,740	12,771	114,941	28,265	90.0	10.0	728	10.6
159,640	1,000	.0208	.0034	.0174	10,440	17,226	142,414	27,473	89.2	10.8	901	11.6
191,568	1,200	.0260	.0048	.0212	12,720	20,988	170,580	28,166	89.0	11.0	1,080	11.8
239,460	1,500	.0350	.0068	.0282	16,920	27,918	211,542	40,962	88.3	11.7	1,339	12.6
271,388	1,700	.0434	.0088	.0346	20,760	34,254	237,134	25,592	87.4	12.6	1,501	13.8
303,316	1,900	.0550	.0124	.0426	25,560	42,174	261,142	24,008	86.1	13.9	1,653	15.5
318,000	1,990	Ultimate strength.										

CONCRETE COLUMN No. 1584.

1: 2: 4 Mixture. Pebbles. Reënforced with 8—⅝″ corrugated bars. Age, 3 months 14 days.

Sectional area of column, gross, 159.52 square inches; net, 156.43 square inches.

Sectional area of steel bars, mean, 3.09 square inches.

Applied loads.		On 50″ gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Lbs.*	*Pounds.*	*Lbs.*			*Lbs.*	
15,952	100	0.	0.	0.								
31,904	200	.0015	.0002	.0013	780	2,410	29,494	....	92.4	7.6	189	4.1
47,856	300	.0032	.0005	.0027	1,620	5,006	42,850	13,356	89.5	10.5	274	5.9
63,808	400	.0048	.0007	.0041	2,460	7,601	56,207	13,357	88.1	11.9	359	6.9
95,712	600	.0083	.0011	.0072	4,320	13,349	82,363	26,156	86.1	13.9	527	8.2
127,616	800	.0117	.0016	.0101	6,060	18,725	108,891	26,528	85.3	14.7	696	8.7
159,520	1,000	.0156	.0022	.0134	8,040	24,844	134,676	25,785	84.4	15.6	861	9.3
191,424	1,200	.0193	.0028	.0165	9,900	30,591	160,833	26,157	84.0	16.0	1,028	9.6
239,280	1,500	.0255	.0039	.0216	12,960	40,046	199,234	38,401	83.3	16.7	1,274	10.2
271,184	1,700	.0298	.0048	.0250	15,000	46,350	224,834	25,600	82.9	17.1	1,437	10.4
319,040	2,000	.0376	.0062	.0314	18,840	58,216	260,824	35,990	81.8	18.2	1,667	11.3
398,800	2,500	.0522	.0083	.0439	26,340	81,391	317,409	56,585	79.6	20.4	2,029	13.0
452,000	2,830	Ultimate strength.										

CONCRETE COLUMN NO. 1579.

1 : 2 : 4 Mixture. Pebbles. Reënforced with 8—¾" Thacher bars. Age, 3 months 12 days.

Sectional area of column, gross, 158.5 square inches; net, 155.19 square inches.

Sectional area of steel bars, mean, 3.31 square inches.

Applied loads.		On 50" gauged length.			Computed. stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Lbs.*	*Pounds.*	*Lbs.*			*Lbs.*	
15,850	100	0.	0.	0.	....	....	....	....	....	....	....	....
31,700	200	.0009	0.	.0009	540	1,787	29,913	....	94.4	5.6	193	2.8
47,550	300	.0021	0.	.0021	1,260	4,171	43,379	13,466	91.2	8.8	280	4.5
63,400	400	.0035	.0001	.0034	2,040	6,752	56,648	13,269	89.4	10.6	365	5.6
79,250	500	.0049	.0001	.0048	2,880	9,533	69,717	13,069	88.0	12.0	449	6.4
95,100	600	.0065	.0002	.0063	3,780	12,512	82,588	12,871	86.8	13.2	532	7.1
110,950	700	.0081	.0004	.0077	4,620	15,292	95,658	13,070	86.2	13.8	616	7.5
126,800	800	.0097	.0004	.0093	5,580	18,470	108,330	12,672	85.4	14.6	698	8.0
142,650	900	.0112	.0005	.0107	6,420	21,250	121,400	13,070	85.1	14.9	782	8.2
158,500	1,000	.0128	.0006	.0122	7,320	24,229	134,271	12,871	84.7	15.3	865	8.5
174,350	1,100	.0145	.0007	.0138	8,280	27,407	146,943	12,672	84.3	15.7	947	8.7
190,200	1,200	.0164	.0009	.0155	9,300	30,783	159,417	12,474	83.8	16.2	1,030	9.0
206,050	1,300	.0181	.0010	.0171	10,260	33,961	172,089	12,672	83.5	16.5	1,109	9.3
237,750	1,500	.0216	.0013	.0203	12,180	40,316	197,434	25,345	83.0	17.0	1,272	9.6
269,450	1,700	.0255	.0016	.0239	14,340	47,465	221,985	24,551	82.4	17.6	1,430	10.0
301,150	1,900	.0297	.0021	.0276	16,560	54,814	246,336	24,351	81.8	18.2	1,587	10.4
317,000	2,000	.0320	.0024	.0296	17,760	58,786	258,214	11,878	81.5	18.5	1,664	10.7
380,400	2,400	.0411	.0035	.0376	22,560	74,674	305,726	47,512	80.4	19.6	1,970	11.5
412,100	2,600	.0484	.0047	.0437	26,220	86,788	325,312	19,586	78.9	21.1	2,096	12.5
438,000	2,760	Ultimate strength.										

CONCRETE COLUMN NO. 1610.

1 : 2 : 4 Mixture. Pebbles. Reënforced with 4—¾" twisted bars. Age, 7 months 26 days.

Sectional area of column, gross, 159.39 square inches; net, 157.08 square inches.

Sectional area of steel bars, 2.31 square inches.

Applied loads.		On 50" gauged length.			Computed. stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total	Per square inch	Compression	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Lbs.*	*Pounds.*	*Lbs.*			*Lbs.*	
15,939	100	0.	0.	0.	....	....	....	....	....	....	....	....
31,878	200	.0015	.0002	.0013	780	1,802	30,076	....	94.3	5.7	191	4.1
47,818	300	.0032	.0004	.0028	1,680	3,881	43,937	13,861	91.9	8.1	280	6.0
63,757	400	.0053	.0007	.0046	2,760	6,376	57,381	13,444	90.0	10.0	365	7.6
79,696	500	.0074	.0008	.0066	3,960	9,148	70,548	13,167	88.5	11.5	449	8.8
95,635	600	.0097	.0010	.0087	5,220	12,058	83,577	13,029	87.4	12.6	532	9.8
111,574	700	.0119	.0012	.0107	6,420	14,830	96,744	13,167	86.7	13.3	616	10.4
127,514	800	.0144	.0015	.0129	7,740	17,879	109,635	12,891	86.0	14.0	698	11.1
143,453	900	.0169	.0019	.0150	9,000	20,790	122,663	13,028	85.5	14.5	781	11.5
159,392	1,000	.0195	.0023	.0172	10,320	23,839	135,553	12,890	85.0	15.0	863	12.0
175,331	1,100	.0219	.0028	.0191	11,460	26,473	148,858	13,305	84.9	15.1	948	12.1
191,270	1,200	.0246	.0031	.0215	12,900	29,799	161,471	12,613	84.4	15.6	1,028	12.5
239,088	1,500	.0319	.0042	.0277	16,620	38,392	200,696	39,225	83.9	16.1	1,278	13.0
289,800	1,820	Ultimate strength.										

CINDER CONCRETE COLUMN NO. 1616.

1 : 2 : 4 Mixture. Cinders. Reënforced with 4—¾″ twisted bars. Age, 5 months 16 days.

Sectional area of column, gross, 159.39 square inches; net, 157.08 square inches.

Sectional area of steel bars, 2.31 square inches.

Applied loads.		On 50″ gauged length.			Computed. stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Lbs.*	*Pounds.*	*Lbs.*			*Lbs.*	
15,939	100	0.	0.	0.								
31,878	200	.0029	0.	.0029	1,740	4,019	27,859		87.4	12.6	177	9.8
47,817	300	.0059	.0002	.0057	3,420	7,900	39,917	12,058	83.5	16.5	254	13.5
63,756	400	.0093	.0005	.0088	5,280	12,197	51,559	11,642	80.9	19.1	328	16.1
79,695	500	.0127	.0008	.0119	7,140	16,493	63,202	11,643	79.3	20.7	402	17.8
95,634	600	.0161	.0010	.0151	9,060	20,929	74,705	11,503	78.1	21.9	476	19.0
127,512	800	.0233	.0016	.0217	13,020	30,076	97,436	22,731	76.4	23.6	620	21.0
159,390	1,000	.0305	.0021	.0284	17,040	39,362	120,028	22,592	75.3	24.7	764	22.3
191,268	1,200	.0381	.0029	.0352	21,120	48,787	142,481	22,453	74.5	25.5	907	23.3
207,207	1,300	.0424	.0034	.0390	23,400	54,054	153,153	10,672	73.9	26.1	975	24.0
239,085	1,500	.0503	.0041	.0462	27,720	64,033	175,052	21,899	73.2	26.8	1,114	24.9
270,963	1,700	.0591	.0053	.0538	32,280	74,567	196,396	21,344	72.5	27.5	1,250	25.8
286,902	1,800	.0635	.0056	.0579	34,740	80,249	206,653	10,257	72.0	28.0	1,316	26.4
334,000	2,095	Ultimate strength.										

CONCRETE COLUMN NO. 1608.

1 : 3 : 6 Mixture. Pebbles. Reënforced with 4—¾″ twisted bars. Age, 7 months 24 days.

Sectional area of column, gross, 160 square inches; net, 157.69 square inches.

Sectional area of steel bars, 2.31 square inches.

Applied loads.		On 50″ gauged length.			Computed. stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Lbs.*	*Pounds.*	*Lbs.*			*Lbs.*	
16,000	100	0.	0.	0.								
32,000	200	.0047	.0009	.0038	2,280	5,267	26,733		83.5	16.5	170	13.4
48,000	300	.0093	.0019	.0074	4,440	10,256	37,744	11,011	78.6	21.4	239	18.6
64,000	400	.0138	.0027	.0111	6,660	15,385	48,615	10,871	76.0	24.0	308	21.6
80,000	500	.0179	.0033	.0146	8,760	20,236	59,764	11,149	74.7	25.3	379	23.1
96,000	600	.0223	.0038	.0185	11,100	25,641	70,359	10,595	73.3	26.7	446	24.9
112,000	700	.0274	.0044	.0230	13,800	31,878	80,122	9,763	71.5	28.5	508	27.2
128,000	800	.0322	.0049	.0273	16,380	37,838	90,162	10,040	70.4	29.6	572	28.6
144,000	900	.0380	.0055	.0325	19,500	45,045	98,955	8,793	68.7	31.3	628	31.1
160,000	1,000	.0441	.0063	.0378	22,680	52,391	107,609	8,654	67.3	32.7	682	33.3
218,600	1,370	Ultimate strength.										

CONCRETE COLUMN NO. 1617.

1 : 3 : 6 Mixture. Trap rock. Reënforced with 8—⅝″ corrugated bars. Age, 5 months 10 days.

Sectional area of column, gross, 159.39 square inches; net, 156.30 square inches.

Sectional area of steel bars, mean, 3.09 square inches.

Applied loads.		On 50″ gauged length.			Computed. stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Lbs.*	*Pounds.*	*Lbs.*			*Lbs.*	
15,939	100	0.	0.	0.								
31,878	200	.0013	0.	.0013	780	2,410	29,468	....	92.4	7.6	189	4.1
47,817	300	.0031	.0002	.0029	1,740	5,377	42,440	12,972	88.8	11.2	272	6.4
63,756	400	.0049	.0005	.0044	2,640	8,158	55,598	13,158	87.2	12.8	356	7.4
79,695	500	.0069	.0006	.0063	3,780	11,680	68,015	12,417	85.3	14.7	435	8.7
95,634	600	.0090	.0009	.0081	4,860	15,017	80,617	12,602	84.3	15.7	516	9.4
127,512	800	.0134	.0015	.0119	7,140	22,063	105,449	24,832	82.7	17.3	675	10.6
143,451	900	.0158	.0019	.0139	8,340	25,771	117,680	12,231	82.0	18.0	753	11.1
159,390	1,000	.0185	.0023	.0162	9,720	30,035	129,355	11,675	81.2	18.8	828	11.7
191,268	1,200	.0239	.0033	.0206	12,360	38,192	153,076	23,721	80.0	20.0	979	12.6
207,207	1,300	.0268	.0037	.0231	13,860	42,827	164,380	11,304	79.3	20.7	1,052	13.2
223,146	1,400	.0300	.0041	.0259	15,540	48,019	175,127	10,747	78.5	21.5	1,120	13.9
239,085	1,500	.0337	.0048	.0289	17,340	53,581	185,504	10,377	77.6	22.4	1,187	14.6
255,024	1,600	.0371	.0049	.0322	19,320	59,699	195,325	9,821	76.6	23.4	1,250	15.4
270,963	1,700	.0409	.0055	.0354	21,240	65,632	205,331	10,006	75.8	24.2	1,314	16.2
286,902	1,800	.0449	.0062	.0387	23,220	71,750	215,152	9,821	75.0	25.0	1,377	16.9
302,841	1,900	.0493	.0065	.0428	25,680	79,351	223,490	8,338	73.8	26.2	1,430	18.0
318,780	2,000	.0540	.0069	.0471	28,260	87,323	231,457	7,967	72.6	27.4	1,481	19.1
365,000	2,290	Ultimate strength.										

STEEL REËNFORCING BARS.

TENSILE AND COMPRESSIVE TESTS OF METAL USED IN CONCRETE COLUMNS.

TENSILE TESTS OF STEEL BARS REPRESENTING REËNFORCING MATERIAL IN CONCRETE COLUMNS.

No. 8057.

Plain, square steel bar.
Diameter, ″.75 by ″.75.
Sectional area, .5625 square inch.
Length over all, 50″.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0030	....	
20,000	.0063	....	
30,000	.0100	0.	
35,000	.0118	....	
36,000	.0121	....	
37,000	.0127	....	
38,000	.0131	....	
39,000	.0136	....	
40,000	.0140	.0004	
41,000	.0144	....	
42,000	.0150	....	
43,000	.0159	....	
44,000	.0168	....	Elastic limit; approximate.
45,000	.0178	.0028	
46,000	.0201	....	
47,000	.0950	....	
48,000	.27	....	
49,000	.28	....	
50,000	.30	....	
51,000	.32	....	
52,000	.34	....	
54,000	.44	....	
56,000	.50	....	
58,000	.56	....	
60,000	.70	....	
62,000	.83	....	
64,000	.99	....	
66,000	1.31	....	
67,020	1.78	....	Tensile strength.
0	1.96	....	=19.6 per cent.

Load on bar at time of rupture, 30,100 pounds = 122,860 pounds per square inch on area at fracture.

Elongation of inch sections, ″.20, ″.18, ″.17, ″.20, ″.19, ″.19, ″.19, ″.21, ″.20, ″.23.

Area at fracture, ″.49 × ″.50 = .2450 square inch.

Contraction of area, 56.4 per cent.

Appearance of fracture, fine silky.

Fractured 2″.25 outside gauged length.

No. 8058.

Twisted, square bar, from the same bar as specimen No. 8057, twisted cold one turn in 8″.

Diameter, ″.75 by ″.75.

Sectional area, .5625 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0032	....	
20,000	.0070	....	
30,000	.0109	0.	
35,000	.0130	0.	
40,000	.0149	.0001	
41,000	.0151	....	
42,000	.0155	....	
43,000	.0160	....	
44,000	.0162	....	
45,000	.0169	.0005	
46,000	.0172	....	
47,000	.0178	....	
48,000	.0183	....	
49,000	.0187	....	
50,000	.0192	.0010	
51,000	.0200	....	
52,000	.0203	....	
53,000	.0209	....	
54,000	.0218	....	
55,000	.0222	.0021	
56,000	.0228	....	
57,000	.0239	....	
58,000	.0246	....	
59,000	.0258	....	
60,000	.0268	.0049	
61,000	.0278	....	
62,000	.0290	....	
63,000	.0300	....	
64,000	.0321	....	
65,000	.0344	.0110	
66,000	.0362	....	
67,000	.0380	....	
68,000	.0399	....	
69,000	.0442	....	
70,000	.0485	.0230	
71,000	.0521	....	
72,000	.0600	....	
73,000	.0658	....	
74,000	.0760	....	
75,000	.0862	.0590	
76,000	.11	....	
77,000	.13	....	
78,000	.15	....	
79,000	.19	....	
80,000	.23	....	
81,000	.25	....	
82,000	.31	....	
83,000	.39	....	
84,000	.42	....	
84,800	....	....	Tensile strength.
0	1.06	....	=10.6 per cent.

Load on bar at time of rupture, 33,900 pounds =132,940 pounds per square inch on area at fracture.

Area at fracture, ″.50×″.51 =.2550 square inch.

Contraction of area, 54.7 per cent.

Appearance of fracture, fine silky, serrated.

Fractured ″.75 inside the gauged length.

No. 8060.

Thacher bar.

Diameter of circular section, ″.75; area, .442 square inch.

Mean sectional area, computed from weight of bar, .414 square inch.

Loads per square inch refer to mean sectional area.

Gauged length, 10″.

Length over all, 50″. Weight, 5.875 pounds.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
10,000	.0031	....	
20,000	.0070	....	
30,000	.0105	0.	
35,000	.0124	....	
40,000	.0142	.0004	
41,000	.0149	....	
42,000	.0155	....	
43,000	.0160	....	Elastic limit.
44,000	.0168	....	
45,000	.0196	.0048	
46,000	.0253	....	
47,000	.0298	....	
48,000	.0310	....	
49,000	.0580	....	
50,000	.0790	.0609	
52,000	.09	....	
54,000	.11	....	
56,000	.12	....	
58,000	.14	....	
60,000	.16	....	
62,000	.19	....	
64,000	.22	....	
66,000	.25	....	
68,000	.30	....	
70,000	.37	....	
72,000	.48	....	
74,000	.61	....	
76,000	.82	....	Tensile strength.
0	.89	....	=8.9 per cent.

Diameter at fracture, ″.52; area, .212 square inch.

Contraction of area, computed on original sectional area of .442 square inch, 52 per cent.

Appearance of fracture, fine silky. Fracture occurred across circular section originally ″.75 diameter.

Fractured 3″ outside the gauged length.

No. 8062.

Corrugated bar. Bar straightened after having been used in concrete column.

Maximum diameter, about ″.65 by ″.67; area, .4355 square inches.

Mean sectional area, computed from weight of bar, .386 square inch.

Loads per square inch refer to mean sectional area.

Gauged length, 10.″

Length over all, 58″.30. Weight, 6.375 pounds.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0030	....	
20,000	.0068	....	
30,000	.0107	0.	
35,000	.0125	....	
40,000	.0134	.0001	
45,000	.0170	....	
50,000	.0211	.0031	
51,000	.0240	....	
52,000	.0320	....	
53,000	.0432	....	
54,000	.1060	....	
55,000	.17	....	
56,000	.19	....	
57,000	.20	....	
58,000	.21	....	
59,000	.22	....	
60,000	.23	....	
62,000	.26	....	
64,000	.30	....	
66,000	.33	....	
68,000	.37	....	
70,000	.41	....	
72,000	.45	....	
74,000	.52	....	
76,000	.60	....	
78,000	.68	....	
80,000	.82	....	
82,000	.98	....	
84,000	1.35	....	
85,230	....	....	Tensile strength.
0	1.75	....	=17.5 per cent.

Appearance of fracture, fine granular.

COMPRESSION TESTS OF STEEL BARS REPRESENTING REËNFORCING MATERIAL IN CONCRETE COLUMNS.

Twisted steel bar.
Length over all, 8″.
Sectional area, ″.79 × ″.80 = .632 square inch.
Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
632	1,000	0.	0.	Initial load.
3,160	5,000	.0007	....	
6,320	10,000	.0017	....	
12,640	20,000	.0035	....	
18,960	30,000	.0056	0.	
25,280	40,000	.0077	0.	
28,440	45,000	.0088	....	
31,600	50,000	.0100	.0003	
32,232	51,000	.0103	....	
32,864	52,000	.0105	....	
33,496	53,000	.0107	....	
34,128	54,000	.0110	....	
34,760	55,000	.0113	.0008	
35,392	56,000	.0116	....	
36,024	57,000	.0119	....	
36,656	58,000	.0125	....	
37,288	59,000	.0130	....	
37,920	60,000	.0134	.0016	
38,552	61,000	.0139	....	
39,184	62,000	.0145	....	
39,816	63,000	.0151	....	
40,448	64,000	.0160	....	
41,080	65,000	.0174	.0045	
41,712	66,000	.0185	....	
42,344	67,000	.0200	....	
42,976	68,000	.0240	.0103	Test discontinued. Ultimate strength not reached.

Second twisted steel bar.
Length over all, 8″.
Sectional area, ″.75 × ″.76 = .57 square inch.
Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
570	1,000	0.	0.	Initial load.
2,850	5,000	.0006	0.	
5,700	10,000	.0015	....	
11,400	20,000	.0036	....	
17,100	30,000	.0057	0.	
22,800	40,000	.0079	....	
25,650	45,000	.0090	....	
28,500	50,000	.0102	.0007	
29,070	51,000	.0106	....	
29,640	52,000	.0109	....	
30,210	53,000	.0113	....	
30,780	54,000	.0115	....	
31,350	55,000	.0118	.0013	
31,920	56,000	.0122	....	
32,490	57,000	.0126	....	
33,060	58,000	.0130	....	
33,630	59,000	.0134	....	
34,200	60,000	.0139	.0021	
34,770	61,000	.0145	....	
35,340	62,000	.0149	....	
35,910	63,000	.0154	....	
36,480	64,000	.0161	....	
37,050	65,000	.0166	.0038	
37,620	66,000	.0174	....	
38,190	67,000	.0182	....	
38,760	68,000	.0192	....	
39,330	69,000	.0202	....	
39,900	70,000	.0212	.0072	Test discontinued. Ultimate strength not reached.

Corrugated steel bar.
Length over all, 8″.
Sectional area, ″.67 × ″.65 = .4355 square inch.
Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
436	1,000	0.	0.	Initial load.
2,178	5,000	.0010	0.	
4,355	10,000	.0019	....	
8,710	20,000	.0041	....	
13,065	30,000	.0068	0.	
15,243	35,000	.0079	....	
17,420	40,000	.0094	.0006	
19,596	45,000	.0110	....	
21,775	50,000	.0128	.0010	
22,211	51,000	.0133	....	
22,646	52,000	.0140	....	
22,900	52,580	....	....	Ultimate strength.

Failed by triple flexure.

Second corrugated steel bar.
Length over all, 8″.
Sectional area, ″.67 × ″.65 = .4355 square inch.
Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
436	1,000	0.	0.	Initial load.
2,178	5,000	.0009	0.	
4,355	10,000	.0020	....	
8,710	20,000	.0043	....	
13,065	30,000	.0068	0.	
15,243	35,000	.0079	....	
17,420	40,000	.0090	.0002	
17,856	41,000	.0092	....	
18,291	42,000	.0094	....	
18,721	43,000	.0096	....	
19,162	44,000	.0099	....	
19,598	45,000	.0101	....	
20,033	46,000	.0103	....	
20,469	47,000	.0105	....	
20,904	48,000	.0107	....	
21,340	49,000	.0110	....	
21,775	50,000	.0112	.0002	
22,211	51,000	.0114	....	
22,646	52,000	.0115	....	
22,900	52,580	....	....	Ultimate strength.

Failed by triple flexure.

Thacher bar.
Length over all, 8″.
Diameter of cylindrical part, ″.76.
Sectional area, .4536 square inch.
Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
454	1,000	0.	0.	Initial load
2,268	5,000	.0011	0.	
4,536	10,000	.0020	....	
9,072	20,000	.0040	....	
13,608	30,000	.0066	.0004	
14,062	31,000	.0071	....	
14,515	32,000	.0073	....	
14,969	33,000	.0075	....	
15,422	34,000	.0079	....	
15,876	35,000	.0083	.0007	
16,330	36,000	.0086	....	
16,783	37,000	.0090	....	
17,237	38,000	.0095	....	
17,690	39,000	.0104	....	
18,144	40,000	.0117	.0030	
18,598	41,000	.0173	....	
19,051	42,000	.0245	....	
22,600	49,820	....	....	Ultimate strength.

Failed by triple flexure.

Second Thacher bar.
Length over all, 8″.02.
Diameter of cylindrical part, ″.75.
Sectional area, .4418 square inch.
Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
442	1,000	0.	0.	Initial load.
2,209	5,000	.0009	0.	
4,418	10 000	.0018	....	
8,836	20,000	.0037	....	
13,254	30,000	.0059	0.	
13,696	31,000	.0060	....	
14,138	32,000	.0062	....	
14,579	33,000	.0064	....	
15,021	34,000	.0067	....	
15,463	35,000	.0069	0.	
15,905	36,000	.0070	....	
16,347	37,000	.0072	....	
16,788	38,000	.0074	....	
17,230	39,000	.0076	....	
17,672	40,000	.0085	.0003	
18,114	41,000	.0090	....	
18,556	42,000	.0099	....	
18,997	43,000	.0116	....	
19,439	44,000	.0129	....	
19,881	45,000	.0155	.0059	
20,323	46,000	.0175	....	
20,765	47,000	.0215	....	
21,206	48,000	.0252	....	
21,648	49,000	.0287	....	
22,090	50,000	.0500	.0401	Rapid lateral deflection. Ultimate strength.

Failed by triple flexure.

Square steel bar.
Length over all, 8″.
Sectional area, ″.75 × ″.75 = .5625 square inch.
Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
563	1,000	0.	0.	Initial load.
2,813	5,000	.0005	0.	
5,625	10,000	.0015	....	
8,438	15,000	.0020	....	
11,250	20,000	.0030	....	
14,063	25,000	.0039	....	
16,875	30,000	.0048	.0005	
19,688	35,000	.0058	....	
22,500	40,000	.0067	.0005	
23,063	41,000	.0069	....	
23,625	42,000	.0072	....	
24,188	43,000	.0073	....	
24,750	44,000	.0075	....	
25,313	45,000	.0078	.0005	
25,875	46,000	.0079	....	
26,438	47,000	.0080	....	
27,000	48,000	.0082	....	
27,563	49,000	.0100	....	
28,125	50,000	.0260	.0176	
29,200	51,910	....	....	Ultimate strength.

Failed by triple flexure.

Second square steel bar.
Length over all, 8".
Sectional area, ".75 × ".75 = .5625 square inch.
Gauged length, 6".

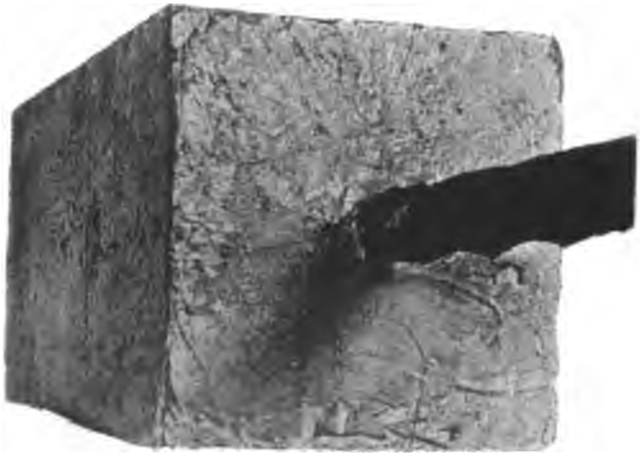
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
563	1,000	0.	0.	Initial load.
2,813	5,000	.0008	0.	
5,625	10,000	.0017	....	
11,250	20,000	.0031	....	
16,875	30,000	.0055	0.	
22,500	40,000	.0075	0.	
23,063	41,000	.0077	....	
23,625	42,000	.0079	....	
24,188	43,000	.0081	....	
24,750	44,000	.0083	....	
25,313	45,000	.0085	0.	
25,875	46,000	.0089	....	
26,438	47,000	.0093	....	
27,000	48,000	.0140	....	
27,563	49,000	.0189	....	
28,125	50,000	....	....	Ultimate strength.

Failed by triple flexure.

Twisted steel bar made from ¾" square steel of previous lot tested.
Length over all, 8".
Sectional area, ".75 × ".75 = .5625 square inch.
Gauged length, 6".

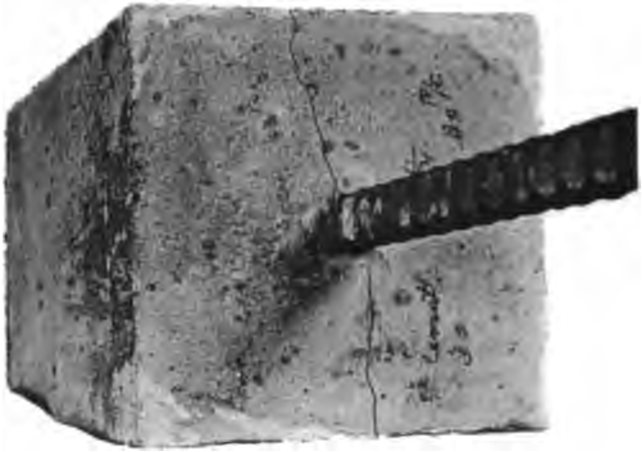
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds*	*Inch.*	*Inch.*	
563	1,000	0.	0.	Initial load.
2,813	5,000	.0009	0.	
5,625	10,000	.0017	....	
11,250	20,000	.0034	....	
16,875	30,000	.0055	....	
22,500	40,000	.0073	0.	
25,313	45,000	.0084	....	
28,125	50,000	.0095	.0001	
30,938	55,000	.0109	....	
33,750	60,000	.0125	.0014	
36,563	65,000	.0150	....	
39,375	70,000	.0198	.0064	Test discontinued. Ultimate strength not reached.

ADHESIVE RESISTANCE OF STEEL BARS IMBEDDED IN CEMENT AND MORTAR PRISMS.



PHOTOGRAPH, BEFORE TESTING, OF TWISTED BAR EMBEDDED
IN PRISM OF NEAT CEMENT, SHOWING CRACKS IN
PRISM AT CORNERS OF BAR.

[illegible]



PHOTOGRAPH, BEFORE TESTING, OF CORRUGATED BAR EMBEDDED IN PRISM OF NEAT CEMENT, SHOWING CRACKS IN PRISM AT CORNERS OF BAR.

HELIOTYPE CO., BOSTON.

Cement and mortar prisms having the nominal dimensions 6″ by 6″ by 12″ long were made, with steel bars imbedded therein. The bars passed centrally through the prisms, projecting at one end to admit of being gripped in the jaws of the testing machine. The specimens were set in air and tested when seven months old. During this period cracks developed in the cement about the imbedded bars, as shown in the photographs herewith.

The tests were made by pulling the bars from the prisms, or rupturing the former by tensile stresses, in case the adhesive resistance was adequate. The prisms were secured in the jaws of the testing machine between V-shaped wooden cushions, against which a sufficient compressive force was applied to hold the specimens in place against the tensile pull on the bars. This lateral pressure on the sides of the prisms prevented their splitting lengthwise during the tests, and in some degree probably resulted in applying pressure against the sides of the imbedded bars, the extent of which was not ascertained.

The area of contact surface between the twisted bars and the cement was taken to be the periphery of the bar multiplied by its length in the prism. In computing the contact surface of the corrugated bars, the periphery was assumed to be represented by the square circumscribing the corrugations. A part of the prism thus inclosed would be subjected to shearing stresses.

ADHESIVE RESISTANCE OF STEEL BARS IMBEDDED IN CEMENT AND MORTAR PRISMS.

Nominal dimensions of prisms 6″ by 6″ by 12″ long. Effective sizes of rods taken as, twisted, ″.81 by ″.81; corrugated, ″.73 by ″.73.

Composition of prisms.	Kind of imbedded bars.	Length of prisms.	Contact surface of bars in prisms.	Ultimate resistance.		Remarks.
				Total.	Per square inch.	
		Inches.	*Sq. ins.*	*Pounds*	*Pounds*	
Atlas cement, neat.......	Twisted....	12.10	39.20	50,100	1,278	Broke rod.
Do....................	.....do......	12.13	39.30	51,200	1,303	Do.
Atlas cement, 1; sand, 1..	.....do......	11.99	38.85	51,200	1,318	Do.
Atlas cement, 1; sand, 2..	.....do......	12.02	38.94	46,700	1,199	Do.
Atlas cement, 1; sand, 3..	.....do......	11.98	38.82	27,200	701	Rod pulled out.
Atlas cement, 1; sand, 4..	.....do......	12.06	39.07	31,100	798	Do.
Atlas cement, neat.......	Corrugated	11.99	35.01	33,900	968	Broke rod.
Do....................	.....do......	12.04	35.16	33,700	958	Do.
Do....................	.....do......	12.06	35.19	33,800	960	Do.
Atlas cement, 1; sand, 1..	.....do......	11.82	34.51	33,700	977	Rod pulled out.
Atlas cement, 1; sand, 2..	.....do......	12.10	35.33	33,000	934	Do.
Atlas cement, 1; sand, 3..	.....do......	12.02	35.10	25,800	735	Do.
Atlas cement, 1; sand, 4..	.....do......	12.02	35.10	19,800	564	Do.

CEMENT CYLINDERS SET UNDER HIGH INITIAL PRESSURES.

No. 1602.

Neat Vulcanite cement.

Water used, 5 per cent of cement, by weight.

Cylinder set under pressure of 400,000 pounds (18,690 pounds per square inch) 25 minutes, then under 217,000 pounds (10,140 pounds per square inch) 42 hours. Remained in mold 21 days, then forced out and set in air until tested.

Weight, 23 pounds 10 ounces = 139.8 pounds per cubic foot.

Age, set in air, 4 months 18 days; first 21 days in mold.

Diameter, 5″.22.

Sectional area, 21.40 square inches.

Length over all, 13.″65. Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,140	100	0.	0.	Initial load.
4,280	200	.0003	....	
8,560	400	.0006	....	
12,840	600	.0010	....	
17,120	800	.0012	....	
21,400	1,000	.0015	.0004	
32,100	1,500	.0019	....	
42,800	2,000	.0025	.0005	
53,500	2,500	.0032	....	
64,200	3,000	.0037	.0007	
74,900	3,500	.0044	....	
85,600	4,000	.0049	.0003	
96,300	4,500	.0053	....	Circumferential crack in sight.
107,000	5,000	.0065	.0005	E (1,000-5,000) = 4,808,000 pounds per square inch.
117,700	5,500	....	....	Ultimate strength.

Failure occurred at the lower end of the cylinder, or end opposite the piston used during the period of setting under pressure. The fractured surfaces presented a chalky appearance. The fragments were porous, readily absorbing water which penetrated to the centers of the pieces. The lower end of the cylinder was less compact and strong than the upper end.

The pressure applied during setting was less effective at the lower end than at the upper end of the cylinder, attributed to the frictional resistance between the cement and the walls of the mold.

The ultimate strength displayed therefore represented that part of the cylinder which was the less effectively compressed when subjected to initial pressure.

No. 1603.

Neat Vulcanite cement.

Water used, 10 per cent of cement, by weight.

Cylinder set under pressure of 320,000 pounds (14,900 pounds per square inch) 10 minutes; 280,000 pounds (13,035 pounds per square inch) 20 minutes, then under 220,000 pounds (10,240 pounds per square inch) 46 hours. Remained in mold 7 days, then forced out of mold and set in water until tested.

Weight before immersion, 24 pounds 3 ounces = 148.4 pounds per cubic foot.

Weight after immersion, 24 pounds 7.5 ounces = 150.1 pounds per cubic foot.

Age, set in water, 5 months 2 days; first 7 days in mold.

Diameter, 5".23.

Sectional area, 21.48 square inches.

Length over all, 13".10.

Gauged length, 6".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,148	100	0.	0.	Initial load.
4,296	200	.0001	....	
8,592	400	.0003	....	
12,888	600	.0005	....	
17,184	800	.0007	....	
21,480	1,000	.0009	0.	
32,220	1,500	.0014	....	
42,960	2,000	.0019	0.	
53,700	2,500	.0024	....	
64,440	3,000	.0029	0.	
75,180	3,500	.0035	....	
85,920	4,000	.0040	0.	
96,660	4,500	.0044	....	
107,400	5,000	.0050	0.	E (1,000-5,000) = 5,854,000 pounds per square inch.
118,140	5,500	.0055	....	
128,880	6,000	.0061	0.	
139,620	6,500	.0067	....	
150,360	7,000	.0073	.0001	
161,100	7,500	.0078	....	
171,840	8,000	.0084	.0001	
182,580	8,500	.0091	....	
193,320	9,000	.0098	.0003	
204,060	9,500	.0103	....	
214,800	10,000	.0110	.0005	E (5,000-10,000) = 5,455,000 pounds per square inch.
238,000	11,080	....	....	First crack.
262,800	12,230	....	....	Ultimate strength.

Failure occurred at the lower end, or end opposite the piston used during the period of setting under pressure.

No. 1604.

Neat Vulcanite cement.

Water used, 20 per cent of cement, by weight.

Cylinder set under pressure of 111,000 pounds (5,167 pounds per square inch) 41 hours, then forced out of cylindrical mold, requiring 36,000 pounds maximum pressure. Set in water when 7 days old, where it remained until 2 days in air preceding the time of testing.

Weight, 26 pounds 8½ ounces = 149 pounds per cubic foot.

Age, 5 months 24 days.

Diameter, 5".23.

Sectional area, 21.48 square inches.

Length over all, 14".31.

Gauged length, 6".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,148	100	0.	0.	Initial load.
4,296	200	.0001	....	
8,592	400	.0002	....	
12,888	600	.0004	....	
17,184	800	.0006	....	
21,480	1,000	.0009	0.	
32,220	1,500	.0015	....	
42,960	2,000	.0021	.0001	
53,700	2,500	.0026	....	
64,440	3,000	.0031	.0001	
75,180	3,500	.0037	....	
85,920	4,000	.0043	.0001	
96,660	4,500	.0049	....	
107,400	5,000	.0055	.0002	E (1,000-5,000)=5,455,000 pounds per square inch.
118,140	5,500	.0061	....	
128,880	6,000	.0067	.0003	
139,620	6,500	.0074	....	
150,360	7,000	.0081	.0004	
161,100	7,500	.0087	....	
171,840	8,000	.0094	.0005	
182,580	8,500	.0101	....	
193,320	9,000	.0109	.0007	
204,060	9,500	.0118	....	
214,800	10,000	.0127	.0010	E (5,000-10,000)=4,688,000 pounds per square inch.
225,540	10,500	.0134	....	
236,280	11,000	.0142	.0012	
300,300	13,980	....	....	First crack and ultimate strength.

Conical fracture at lower end.

No. 1605.

Neat Vulcanite cement.

Water used, 20 per cent of cement, by weight.

Cylinder set under pressure of 217,000 pounds (10,102 pounds per square inch) 40 hours. Water lost during interval under pressure, 5 ounces. Forced out of cylindrical mold when 6 days old, the pressure required being 160,000 pounds. Set in water when 6 days old, where it remained until tested.

Weight, 27 pounds 3 ounces = 149.4 pounds per cubic foot.

Age, 6 months 1 day.

Diameter, 5″.23.

Sectional area, 21.48 square inches.

Length over all, 14″.62.

Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,148	100	0.	0.	Initial load.
4,296	200	.0001	....	
8,592	400	.0002	....	
12,888	600	.0005	....	
17,184	800	.0007	....	
21,480	1,000	.0009	0.	
32,220	1,500	.0014	....	
42,960	2,000	.0020	0.	
53,700	2,500	.0026	....	
64,440	3,000	.0031	0.	
75,180	3,500	.0037	....	
85,920	4,000	.0043	.0001	
96,660	4,500	.0048	....	
107,400	5,000	.0055	.0002	E (1,000-5,000) = 5,455,000 pounds per square inch.
118,140	5,500	.0061	....	
128,880	6,000	.0067	.0002	
139,620	6,500	.0073	....	
150,360	7,000	.0080	.0003	
161,100	7,500	.0087	....	
171,840	8,000	.0094	.0003	
182,580	8,500	.0102	....	
193,320	9,000	.0109	.0006	
204,060	9,500	.0119	....	
214,800	10,000	.0127	.0009	E (5,000-10,000) = 4,615,000 pounds per square inch.
338,200	15,740	....	....	First crack and ultimate strength.

No. 1606.

Neat Vulcanite cement.

Water used, 10 per cent of cement, by weight.

Cylinder set under pressure of 217,000 pounds (10,102 pounds per square inch) 42 hours. The mixture heated soon after the water was added, and rose to a temperature of over 100 degrees Fahrenheit. It was too dry and powdery to admit of successful tamping prior to applying pressure in the mold. Removed from the mold when 7 days old and then set in water until tested.

Weight, 21 pounds 12½ ounces = 143.3 pounds per cubic foot.

Age, 6 months 1 day.

Diameter, 5″.23.

Sectional area, 21.48 square inches.

Length over all, 12″.19.

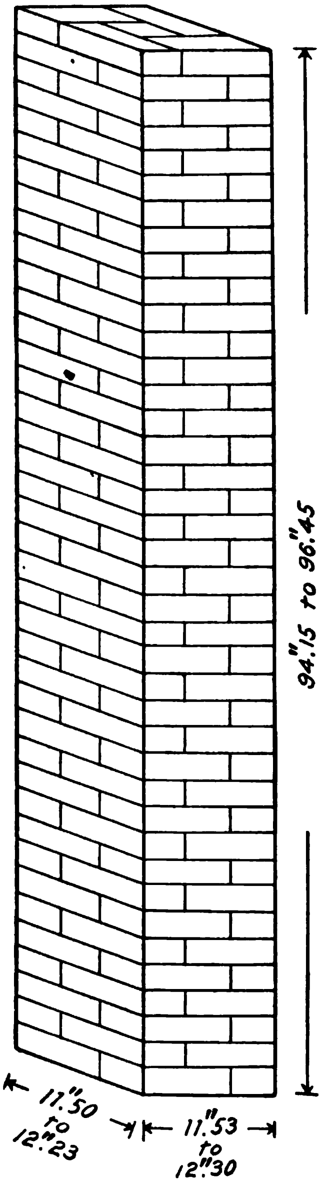
Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,148	100	0.	0.	Initial load.
4,296	200	0.	....	
8,592	400	.0001	....	
12,888	600	.0002	....	
17,184	800	.0005	....	
21,480	1,000	.0007	0.	
32,220	1,500	.0013	....	
42,960	2,000	.0019	−.0001	
53,700	2,500	.0025	....	
64,440	3,000	.0032	−.0001	
75,180	3,500	.0040	....	
85,920	4,000	.0046	−.0001	
96,660	4,500	.0054	....	
107,400	5,000	.0063	0.	E (1,000-5,000)=4,286,000 pounds per square inch.
118,140	5,500	.0071	....	
128,880	6,000	.0082	.0001	
139,620	6,500	.0092	....	
150,360	7,000	.0105	.0005	
161,100	7,500	.0122	....	
171,840	8,000	.0141	.0013	E (5,000-8,000)=2,769,000 pounds per square inch.
174,000	8,100	....	....	First crack and ultimate strength.

BRICK PIERS.

Brick piers, nominally 12" by 12" by 8 feet high, with solid cores, were made of dry-pressed face brick made by the Philadelphia and Boston Face Brick Company; re-pressed mud bricks made by the New England Brick Company, at their Exeter, N. H., yard.; wire-cut face brick, made by Fiske & Co., Boston, and hard and light-hard common sand-struck brick, made by the New England Brick Company.

The sand-struck bricks represent three yards: The West Cambridge, Mass., yard, where about 425 cords of wood per million bricks are used in burning; the East Brookfield, Mass., yard, where about 300 cords of wood per million bricks are used, and the Mechanicsville, N. Y., yard, where about 200 cords of wood per million bricks are used. The piers were laid in neat Portland cement, Vulcanite brand, or in cement mortar, using the same brand of cement as when laid neat, and in lime mortar. Material in part exhibited at the Louisiana Purchase Exposition, St. Louis, Mo., 1904.


94."15 to 96."45
11."50 to 12."23
11."53 to 12."30

No. 1594.

12" FACE BRICK PIER.

Dry-pressed brick from Philadelphia and Boston Face Brick Company.

Built of 40 courses of brick, with solid core.

Laid in neat Vulcanite cement.

Age, 1 month.

Weight, 1,057 pounds = 137.3 pounds per cubic foot.

Height of pier, 95.40 inches.

Sectional area, 11".80 × 11".82 = 139.48 square inches.

Average thickness of joints, ".17.

Gauged length, 50."

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,948	100	0.	0.	Initial load.
27,896	200	.0015	0.	
41,844	300	.0034	.0002	
55,792	400	.0053	.0003	
69,740	500	.0073	....	
83,688	600	.0097	.0005	E (100-600) = 2,717,000 pounds per square inch.
97,636	700	.0118	....	
111,584	800	.0141	.0008	
125,532	900	.0164	....	
139,480	1,000	.0187	.0012	E (600-1,000) = 2,410,000 pounds per square inch.
167,376	1,200	.0232	....	
195,272	1,400	.0278	.0018	
223,168	1,600	.0328	....	
251,064	1,800	.0373	.0026	
278,960	2,000	.0421	.0027	E (1,000-2,000) = 2,283,000 pounds per square inch
306,856	2,200	.0468	....	
334,752	2,400	.0517	.0037	
362,648	2,600	.0573	....	
390,544	2,800	.0627	.0048	
402,000	2,880	....	....	Ultimate strength.

Opened longitudinal cracks along middle of length of pier, separating the bricks of alternate courses into half-bricks, the fractures being opposite the end joints of intermediate courses.

No. 1637.

12" FACE BRICK PIER.

Dry pressed brick from Philadelphia and Boston Face Brick Company.

Built of 39 courses of brick, with solid core.

Laid in cement mortar—1 part Vulcanite cement and 3 parts sand.

Age, 6 months.

Weight, 1,056 pounds = 130 pounds per cubic foot.

Height of pier, 98.37 inches.

Sectional area, 11".95 × 11".94 = 142.68 square inches.

Average thickness of joints, ".33.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,268	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
21,402	150	.0012	.0001	
28,536	200	.0025	.0004	
35,670	250	.0039	.0005	
42,804	300	.0051	.0006	
49,938	350	.0065	.0008	
57,072	400	.0079	.0009	
64,206	450	.0092	.0010	
71,340	500	.0105	.0013	
78,474	550	.0119	.0015	
85,608	600	.0134	.0017	E (100-600) = 2,137,000 pounds per square inch.
99,876	700	.0160	.0019	
114,144	800	.0189	.0021	
128,412	900	.0215	.0026	
142,680	1,000	.0243	.0028	E (600-1,000) = 2,041,000 pounds per square inch.
156,948	1,100	.0270	.0030	
171,216	1,200	.0298	.0035	
185,484	1,300	.0327	.0039	
199,752	1,400	.0359	.0044	
214,020	1,500	.0390	.0050	
228,288	1,600	.0423	.0054	
242,556	1,700	.0454	.0061	
256,824	1,800	.0490	.0068	
271,092	1,900	.0526	.0076	
285,360	2,000	.0561	.0082	E (1,000-2,000) = 1,894,000 pounds per square inch.
299,628	2,100	.0599	.0089	
313,896	2,200	.0642	.0105	Cracks in twelfth and thirteenth courses.
328,164	2,300	.0694	.0116	
342,432	2,400	.0767	.0141	Ultimate strength.

Opened longitudinal cracks in the lower half of the pier.

No. 1628.

12″ FACE BRICK PIER

Dry pressed brick from Philadelphia and Boston Face Brick Company.

Built of 40 courses of brick, with solid core.

Laid in lime mortar—1 part lime and 3 parts sand.

Age, 6 months.

Weight, 982 pounds = 129.0 pounds per cubic foot.

Height of pier, 94.95 inches.

Sectional area, 11″.77 × 11″.76 = 138.42 square inches.

Average thickness of joints, ″.20.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,842	100	0.	0.	Initial load. Loaded with 16,000 pounds before testing.
20,763	150	.0020	.0004	
27,684	200	.0094	.0055	
34,605	250	.0184	.0124	
41,526	300	.0275	.0190	
48,447	350	.0370	.0263	
55,368	400	.0455	.0325	
62,289	450	.0510	.0435	
69,210	500	.0707	.0524	
76,131	550	.0796	.0593	
83,052	600	.0936	.0709	E (100-600) = 1,101,000 pounds per square inch.
96,894	700	.1190	.0915	
110,736	800	.1413	.1090	
124,578	900	.1671	.1303	One brick cracked in second course from bottom
138,420	1,000	.1893	.1479	E (600-1,000) = 1,070,000 pounds per square inch.
152,262	1,100	.2159	.1700	
166,104	1,200	.2423	.1919	
179,946	1,300	.2699	.2145	
193,788	1,400	.2975	.2380	
210,000	1,517	....	....	Ultimate strength.

Opened longitudinal cracks.

No. 1634.

12" FACE BRICK PIER.

Repressed brick from New England Brick Company.
Built of 39 courses of brick, with solid core.
Laid in neat Vulcanite Portland cement.
Age, 5 months 23 days.
Weight, 1,018 pounds = 124.4 pounds per cubic foot.
Height of pier, 97.55 inches.
Sectional area, 12".00 × 12".08 = 144.96 square inches.
Average thickness of joints, ".27.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,496	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
21,744	150	.0022	.0004	
28,992	200	.0048	.0009	
36,240	250	.0073	.0013	
43,488	300	.0099	.0017	
50,736	350	.0125	.0021	
57,984	400	.0150	.0027	
65,232	450	.0177	.0032	
72,480	500	.0204	.0036	
79,728	550	.0230	.0041	
86,976	600	.0258	.0048	E (100-600) = 1,190,000 pounds per square inch
101,472	700	.0305	.0056	Snapping sound.
115,968	800	.0364	.0066	
130,464	900	.0420	.0078	Brick in top course spalled.
144,960	1,000	.0477	.0086	E (600-1,000) = 1,105.000 pounds per square inch.
159,456	1,100	.0534	.0099	
173,952	1,200	.0591	.0107	
188,448	1,300	.0640	.0114	
202,944	1,400	.0695	.0122	
217,440	1,500	.0746	.0130	
231,936	1,600	.0793	.0134	
246,432	1,700	.0842	.0141	
260,928	1,800	.0880	.0143	
275,424	1,900	.0930	.0150	
279,000	1,925	....	....	Ultimate strength

Pier failed at the upper end by opening longitudinal cracks, and bricks in two upper courses crushed.

No. 1625.

12" FACE BRICK PIER.

Repressed bricks from New England Brick Company.
Built of 38 courses of brick, with solid core.
Laid in cement mortar—1 part Vulcanite cement and 3 parts sand.
Age, 5 months 22 days.
Weight, 1,011 pounds = 120.5 pounds per cubic foot.
Height of pier, 97.25 inches.
Sectional area, 12".22 × 12".20 = 149.08 square inches.
Average thickness of joints, "32.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,908	100	0.	0.	Initial load. Loaded with 20,000 pounds before testing.
22,362	150	.0018	0.	
29,816	200	.0040	.0002	
37,270	250	.0064	.0006	
44,724	300	.0088	.0009	
52,178	350	.0114	.0013	
59,632	400	.0137	.0016	
67,086	450	.0163	.0020	
74,540	500	.0188	.0023	
81,994	550	.0214	.0027	
89,448	600	.0240	.0030	E (100–600) = 1,190,000 pounds per square inch.
104,356	700	.0290	.0035	
119,264	800	.0341	.0041	
134,172	900	.0398	.0050	
149,080	1,000	.0456	.0059	E (600–1,000) = 1,070,000 pounds per square inch.
163,988	1,100	.0512	.0068	
178,896	1,200	.0571	.0077	
193,804	1,300	.0635	.0088	
208,712	1,400	.0700	.0101	Snapping sound.
223,620	1,500	.0764	.0111	
238,528	1,600	.0822	.0121	Cracks in 8 lower courses.
249,000	1,670	....	....	Ultimate strength.

Failed at the lower end of pier. Joints were not well filled with mortar in the lower courses.

No. 1630.

12" FACE BRICK PIER.

Repressed mud brick.
Built of 39 courses of brick, with solid core.
Laid in lime mortar—1 part lime and 3 parts sand.
Age, 6 months.
Weight, 953 pounds = 120.5 pounds per cubic foot.
Height of pier, 95.05 inches.
Sectional area, 12".00 × 11".98 = 143.76 square inches.
Average thickness of joints, ".22.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,376	100	0.	0.	Initial load. Loaded with 18,000 pounds before testing.
21,564	150	.0038	.0009	
28,752	200	.0117	.0056	
35,940	250	.0210	.0115	
43,128	300	.0315	.0185	
50,316	350	.0441	.0274	Snapping sounds.
57,504	400	.0566	.0360	
64,692	450	.0723	.0475	
71,880	500	.0856	.0571	
79,068	550	.1027	.0703	
86,256	600	.1184	.0821	E (100-600) = 689,000 pounds per square inch.
100,632	700	.1516	.1076	
115,008	800	.1890	.1375	
129,384	900	.2185	.1602	
143,760	1,000	.2585	.1925	E (600-1,000) = 673,000 pounds per square inch.
158,136	1,100	.2935	.2201	
181,100	1,260	....	....	Ultimate strength.

Opened longitudinal cracks and spalled the bricks near the middle of the length of the pier.

No. 1599

12" FACE BRICK PIER

Wire cut, mud bricks.
Built of 37 courses of brick, with solid core.
Laid in cement mortar—1 part Vulcanite cement and 2 parts sand.
Age, 25 days.
Weight, 1,035 pounds = 133.7 pounds per cubic foot.
Height of pier, 94.15 inches.
Sectional area, 11".92 × 11".92 = 142.09 square inches.
Average thickness of joints, ".20.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,209	100	0.	0.	Initial load.
28,418	200	.0024	.0001	
42,627	300	.0050	.0004	
56,836	400	.0075	.0008	
71,045	500	.0101	.0009	
85,254	600	.0125	.0012	E (100-600) = 2,212,000 pounds per square inch.
99,463	700	.0149	....	
113,672	800	.0175	.0017	
127,881	900	.0205	....	
142,090	1,000	.0228	.0022	E (600-1,000) = 2,151,000 pounds per square inch.
170,506	1,200	.0288	....	
198,926	1,400	.0339	.0036	
227,344	1,600	.0398	....	
255,762	1,800	.0454	.0057	
284,180	2,000	.0531	.0077	E (1,000-2,000) = 2,016,000 pounds per square inch.
312,598	2,200	.0608	....	
341,016	2,400	.0686	.0114	
342,000	2,410	....	....	Ultimate strength.

Opened longitudinal cracks along the upper half of the pier.

No. 1636.

12" FACE BRICK PIER.

Wire cut bricks.
Built of 39 courses of brick, with solid core.
Laid in neat Vulcanite Portland cement.
Age, 5 months 26 days.
Weight, 1,073 pounds = 133.6 pounds per cubic foot.
Height of pier, 98.05 inches.
Sectional area, 11".87 × 11".92 = 141.49 square inches.
Average thickness of joints, ".22.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,149	100	0.	0.	Initial load. Loaded with 18,000 pounds before testing.
21,224	150	.0009	.0001	
28,298	200	.0019	.0001	
35,373	250	.0031	.0004	
42,447	300	.0043	.0005	
49,522	350	.0056	.0006	
56,596	400	.0069	.0008	
63,671	450	.0081	.0010	
70,745	500	.0093	.0010	
77,820	550	.0106	.0012	
84,894	600	.0120	.0015	E (100-600) = 2,381,000 pounds per square inch.
99,043	700	.0144	.0016	Snapping sound.
113,192	800	.0167	.0019	
127,341	900	.0195	.0023	
141,490	1,000	.0218	.0025	E (600-1,000) = 2,273,000 pounds per square inch.
155,639	1,100	.0244	.0029	
169,788	1,200	.0268	.0030	
183,937	1,300	.0295	.0034	
198,086	1,400	.0320	.0035	
212,235	1,500	.0348	.0040	
226,384	1,600	.0365	.0042	
240,533	1,700	.0400	.0047	
258,682	1,800	.0426	.0049	
268,831	1,900	.0453	.0053	
282,980	2,000	.0480	.0056	E (1,000-2,000) = 2,165,000 pounds per square inch.
297,129	2,100	.0507	.0060	
311,278	2,200	.0536	.0065	
325,427	2,300	.0560	.0068	
339,576	2,400	.0588	.0073	
353,725	2,500	.0618	.0076	
367,874	2,600	.0644	.0083	
382,023	2,700	.0676	.0087	
396,172	2,800	.0700	.0089	
410,321	2,900	.0728	.0094	
424,470	3,000	.0758	.0100	Cracks in two courses at middle of length of pier. E (2,000-3,000) = 2,137,000 pounds per square inch.
438,619	3,100	.0784	.0100	
452,768	3,200	.0814	.0106	
569,000	4,021	....	....	Ultimate strength.

Pier failed at the upper end. Opened longitudinal cracks, and bricks in two upper courses spalled off.

No. 1629.

12″ FACE BRICK PIER.

Wire cut bricks.
Built of 39 courses of brick, with solid core.
Laid in lime mortar—1 part lime and 3 parts sand.
Age, 6 months.
Weight, 1,007 pounds = 130.3 pounds per cubic foot.
Height of pier, 96.40 inches.
Sectional area, 11″.80 × 11″.74 = 138.53 square inches.
Average thickness of joints, ″.22.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,853	100	0.	0.	Initial load. Loaded with 22,000 pounds before testing.
20,780	150	.0020	.0002	
27,706	200	.0069	.0028	
34,633	250	.0179	.0115	
41,559	300	.0300	.0210	
48,486	350	.0415	.0298	
55,412	400	.0540	.0399	
62,339	450	.0669	.0505	
69,265	500	.0821	.0635	Snapping sounds.
76,192	550	.0982	.0770	
83,118	600	.1121	.0886	E (100-600) = 1,064,000 pounds per square inch.
96,971	700	.1408	.1156	Cracks in four courses.
110,824	800	.1617	.1298	
124,677	900	.1917	.1555	
138,530	1,000	.2168	.1761	E (600-1,000) = 1,163,000 pounds per square inch.
152,383	1,100	.2389	1931	
166,236	1,200	.2590	1107	
180,089	1,300	.2841	.2319	
193,942	1,400	.3080	.2630	
196,700	1,420	....	....	Ultimate strength.

Opened longitudinal cracks.

No. 1596.

12" COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's Yard No. 5, West Cambridge, Mass.

Built of 41 courses of brick, with solid core.

Laid in neat Vulcanite cement.

Age, 1 month.

Weight, 1,003 pounds = 135.5 pounds per cubic foot.

Height of pier, 96.45 inches.

Sectional area, 11".50 × 11".53 = 132.60 square inches.

Average thickness of joints, ".11.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,260	100	0.	0.	Initial load.
26,520	200	.0020	0.	
39,780	300	.0042	.0002	
53,040	400	.0068	.0007	
66,300	500	.0093	....	
79,560	600	.0118	.0014	E (100–600) = 2,403,000 pounds per square inch.
92,820	700	.0143	....	
106,080	800	.0168	.0022	
119,340	900	.0192	....	
132,600	1,000	.0217	.0027	E (600–1,000) = 2,326,000 pounds per square inch.
159,120	1,200	.0265	....	
185,640	1,400	.0312	.0038	
212,160	1,600	.0367	....	
238,680	1,800	.0409	.0051	
265,200	2,000	.0462	.0058	E (1,000–2,000) = 2,336,000 pounds per square inch.
291,720	2,200	.0514	....	
318,240	2,400	.0558	.0075	
344,760	2,600	.0609	....	
371,280	2,800	.0668	.0102	
397,800	3,000	.0717	.0108	E (2,000–3,000) = 2,430,000 pounds per square inch.
424,320	3,200	.0768	....	
450,840	3,400	.0814	.0122	
477,360	3,600	.0883	....	
503,880	3,800	.0925	.0147	Cracks.
623,600	4,700	....	....	Ultimate strength.

Opened longitudinal cracks along middle of length of pier.

No. 1597.

12" COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's Yard No. 5, West Cambridge, Mass.

Built of 37 courses of brick, with solid core.

Laid in cement mortar—1 part Vulcanite cement and 3 parts sand.

Age, 1 month.

Weight, 994 pounds = 126.9 pounds per cubic foot.

Height of pier, 95.60 inches.

Sectional area, 11".84 × 11".95 = 141.49 square inches.

Average thickness of joints, ".30.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,149	100	0.	0.	Initial load.
28,298	200	.0032	.0002	
42,447	300	.0063	.0006	
56,596	400	.0097	.0011	
70,745	500	.0130	.0016	
84,894	600	.0166	.0022	E (100-600) = 1,736,000 pounds per square inch.
99,043	700	.0204	.0028	
113,192	800	.0236	.0034	
127,341	900	.0282	.0043	
141,490	1,000	.0324	.0053	E (600-1,000) = 1,575,000 pounds per square inch.
169,788	1,200	.0412	.0076	
198,086	1,400	.0515	.0104	
226,384	1,600	.0632	.0146	
254,682	1,800	....	....	Ultimate strength.

Opened longitudinal cracks near the lower end of the pier.

No. 1627.

12" COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's Yard No. 5, West Cambridge, Mass.

Built of 39 courses of brick, with solid core.

Laid in lime mortar—1 part lime and 3 parts sand.

Age, 5 months 27 days.

Weight, 885 pounds = 123.8 pounds per cubic foot.

Height of pier, 94.55 inches.

Sectional area, 11".42 × 11".44 = 130.64 square inches.

Average thickness of joints, ".28.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,064	100	0.	0.	Initial load. Loaded with 7,000 pounds before testing.
19,596	150	.0105	.0089	
26,128	200	.0306	.0254	
32,660	250	.0520	.0495	
39,192	300	.0870	.0750	Snapping sounds.
45,724	350	.1211	.1060	Brick cracked in thirteenth course.
52,256	400	.1440	.1256	
58,788	450	.1819	.1600	
65,320	500	.2144	.1894	
71,852	550	.2428	.2148	
78,384	600	.2747	.2437	E (100–600) = 806,000 pounds per square inch.
84,916	650	.3071	.2738	
129,900	994	....	....	Ultimate strength.

Opened longitudinal cracks.

No. 1595.

12" COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's Yard No. 5, West Cambridge, Mass.

Built of 38 courses of brick, with solid core.

Laid in neat Vulcanite cement.

Age, 1 month.

Weight, 976 pounds = 117.6 pounds per cubic foot.

Height of pier, 96.35 inches.

Sectional area, 12".16 × 12".30 = 149.57 square inches.

Average thickness of joints, ".16.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,957	100	0.	0.	Initial load.
29,914	200	.0053	.0003	
44,871	300	.0116	.0013	
59,828	400	.0186	.0023	
74,785	500	.0257	.0032	
89,742	600	.0328	.0042	E (100-600) = 874,000 pounds per square inch.
104,699	700	.0404	.0052	
119,656	800	.0478	.0062	
134,613	900	.0557	.0074	
149,570	1,000	.0634	.0084	E (600-1,000) = 758,000 pounds per square inch.
164,527	1,100	.0712	.0096	Snapping sounds.
179,484	1,200	.0788	.0108	
194,441	1,300	.0868	.0117	
209,398	1,400	.0952	.0132	
224,355	1,500	.1046	.0147	E (1,000-1,500) = 716,000 pounds per square inch.
226,000	1,510	....	....	Ultimate strength.

Opened longitudinal cracks in lower half of pier.

No. 1619.

12" COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's Yard No. 5, West Cambridge, Mass.

Built of 36 courses of brick, with solid core.

Laid in cement mortar—1 part Vulcanite cement and 3 parts sand.

Age, 6 months.

Weight, 886 pounds = 111.6 pounds per cubic foot.

Height of pier, 96.50 inches.

Sectional area, 11".93 × 11".91 = 142.09 square inches.

Average thickness of joints, ".35.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,200	100	0.	0.	Initial load. Loaded with 20,000 pounds before testing.
21,314	150	.0023	....	
28,418	200	.0047	.0008	
35,523	250	.0073	....	
42,627	300	.0102	.0008	
49,732	350	.0129	....	
56,836	400	.0156	.0013	
63,941	450	.0186	....	
71,045	500	.0214	.0020	
78,150	550	.0243	....	
85,254	600	.0272	.0025	E (100-600) = 1,012,000 pounds per square inch.
99,463	700	.0339	.0036	
113,672	800	.0396	.0038	
127,881	900	.0460	.0044	
142,090	1,000	.0525	.0051	E (600-1,000) = 881,000 pounds per square inch.
156,299	1,100	.0596	.0060	
170,508	1,200	.0674	.0071	
184,717	1,300	.0757	.0085	
198,926	1,400	.0844	.0092	Snapping sound; cracks in 4 courses.
215,800	1,519	....	....	Ultimate strength.

Opened longitudinal cracks along middle of length of pier.

No. 1631.

12" COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's Yard No. 5, West Cambridge, Mass.

Built of 37 courses of brick, with solid core.

Laid in lime mortar—1 part lime and 3 parts sand.

Age, 6 months.

Weight, 864 pounds = 105.2 pounds per cubic foot.

Height of pier, 95.90 inches.

Sectional area, 12".15 × 12".18 = 147.99 square inches.

Average thickness of joints, ".23.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,799	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
22,199	150	.0176	.0121	Snapping sounds.
29,598	200	.0368	.0258	
36,998	250	.0589	.0412	
44,397	300	.0823	.0581	
51,797	350	.1093	.0783	
59,196	400	.1346	.0967	Bricks cracked in 6 courses.
66,596	450	.1624	.1184	
73,995	500	.1953	.1438	
81,395	550	.2244	.1663	
88,794	600	.2730	.2070	E (100–600) = 379,000 pounds per square inch.
96,194	650	.3005	.2880	
108,300	732	....	....	Ultimate strength.

Opened longitudinal cracks. Faces of bricks in 6 courses spalled off.

No. 1620.

12″ COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's Yard No. 5, West Cambridge, Mass.

Built of 37 courses of brick, with solid core.

Laid in lime mortar—1 part lime and 3 parts sand. Panels of bricks were filled with neat Portland cement.

Age, 5 months 14 days.

Weight, 885 pounds = 105.6 pounds per cubic foot.

Height of pier, 97.50 inches.

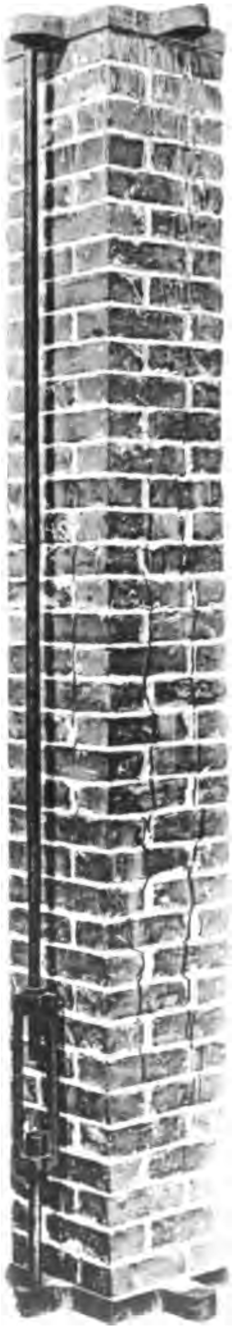
Sectional area, 12″.18 × 12″.19 = 148.47 square inches.

Average thickness of joints, ″.35.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,847	100	0.	0.	Initial load. Loaded with 16,000 pounds before testing.
22,271	150	.0070	.0036	
29,694	200	.0242	.0160	
37,118	250	.0412	.0284	Cracks in 2 courses.
44,541	300	.0644	.0468	
51,965	350	.0883	.0654	
59,388	400	.1116	.0841	
66,812	450	.1404	.1075	
74,235	500	.1673	.1299	
81,659	550	.1920	.1490	E (100-550) = 523,000 pounds per square inch.
120,100	809	....	....	Ultimate strength

Opened longitudinal cracks, separating the bricks into halves.



NO. 1620.

PIER MADE OF LIGHT HARD, SAND STRUCK BRICKS, LAID IN LIME MORTAR, LIME 1, SAND 3. APPEARANCE AFTER TESTING, SHOWING LONGITUDINAL CRACKS DEVELOPED.

HELIOTYPE CO., BOSTON.

No. 1632.

12" COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's yard at East Brookfield, Mass.

Built of 38 courses of brick, with solid core.

Laid in neat Vulcanite Portland cement.

Age, 5 months 20 days.

Weight, 964 pounds = 116.6 pounds per cubic foot.

Height of pier, 97.15 inches.

Sectional area, 12".20 × 12".05 = 147.01 square inches.

Average thickness of joints, ".30.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,701	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
22,052	150	.0033	.0009	
29,402	200	.0066	.0015	
36,753	250	.0096	.0023	Snapping sounds.
44,103	300	.0128	.0029	
51,454	350	.0158	.0034	
58,804	400	.0188	.0040	
66,155	450	.0216	.0045	
73,505	500	.0246	.0051	
80,856	550	.0275	.0056	
88,206	600	.0303	.0060	E (100-600) = 1,029,000 pounds per square inch.
102,907	700	.0358	.0069	
117,608	800	.0416	.0076	
132,309	900	.0474	.0087	
147,010	1,000	.0529	.0095	E (600-1,000) = 1,047,000 pounds per square inch.
161,711	1,100	.0585	.0106	
176,412	1,200	.0645	.0116	
191,113	1,300	.0702	.0127	
205,814	1,400	.0760	.0136	
220,515	1,500	.0817	.0146	
235,216	1,600	.0876	.0158	
249,917	1,700	.0940	.0170	Cracks in 2 lower courses.
264,618	1,800	.1000	.0184	
279,319	1,900	.1070	.0200	
289,500	1,969	....	....	Ultimate strength.

Opened longitudinal cracks in lower half of pier. Bricks crushed in seventh, eighth, and ninth courses.

No. 1633.

12" COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's yard at East Brookfield, Mass.

Built of 37 courses of brick, with solid core.

Laid in cement mortar—1 part Vulcanite cement and 3 parts sand.

Age, 6 months.

Weight, 946 pounds = 114 pounds per cubic foot.

Height of pier, 97.12 inches.

Sectional area, 12".18 × 12".12 = 147.62 square inches.

Average thickness of joints, ".35.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,762	100	0.	0.	Initial load. Loaded with 19,000 pounds before testing.
22,143	150	.0015	0.	
29,524	200	.0034	0.	
36,905	250	.0054	.0002	
44,286	300	.0076	.0005	
51,667	350	.0098	.0008	
59,048	400	.0120	.0010	
66,429	450	.0144	.0012	
73,810	500	.0168	.0015	
81,191	550	.0190	.0019	
88,572	600	.0214	.0021	E (100-600) = 1,295,000 pounds per square inch.
103,334	700	.0257	.0025	
118,096	800	.0305	.0030	
132,858	900	.0355	.0037	
147,620	1,000	.0405	.0042	E (600-1,000) = 1,176,000 pounds per square inch.
162,382	1,100	.0454	.0049	
177,144	1,200	.0505	.0057	
191,906	1,300	.0558	.0063	
206,668	1,400	.0615	.0073	Snapping sounds.
221,430	1,500	.0673	.0082	
236,192	1,600	.0728	.0090	
250,954	1,700	.0789	.0101	
265,716	1,800	.0859	.0117	Cracks in 2 courses near upper end of pier. Ultimate strength.

Pier failed at upper end. Opened longitudinal cracks and bricks crushed. Highest load sustained after the determination of the last set, 255,000 pounds.

No. 1622.

12" COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's yard at East Brookfield, Mass.

Built of 38 courses of brick, with solid core.

Laid in lime mortar—1 part lime and 3 parts sand.

Age, 5 months 26 days.

Weight, 879 pounds = 106.9 pounds per cubic foot.

Height of pier, 96.20 inches.

Sectional area, 12".14 × 12".16 = 147.62 square inches.

Average thickness of joints, ".23.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,762	100	0.	0.	Initial load. Loaded with 17,000 pounds before testing.
22,143	150	.0059	.0025	
29,524	200	.0257	.0179	
36,905	250	.0498	.0383	
44,286	300	.0737	.0555	
51,667	350	.1000	.0770	
59,048	400	.1278	.1008	Cracks in one corner.
66,429	450	.1523	.1193	
73,810	500	.1818	.1436	
			.1431	After resting 16 hours under initial load.
81,191	550	.2007	.1576	
88,572	600	.2348	.1854	E (100–600) = 506,000 pounds per square inch.
95,953	650	.2620	.2083	
108,200	733			Ultimate strength.

Opened longitudinal cracks.

No. 1621.

12″ COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's yard at East Brookfield, Mass.

Built of 37 courses of brick, with solid core.

Laid in lime mortar—1 part lime and 3 parts sand. Panels of bricks were filled with neat Portland cement.

Age, 5 months 14 days.

Weight, 892 pounds = 109.9 pounds per cubic foot.

Height of pier, 97.50 inches.

Sectional area, 11″.99 × 12″.00 = 143.88 square inches.

Average thickness of joints, ″.30.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,388	100	0.	0.	Initial load. Loaded with 18,000 pounds before testing.
21,582	150	.0052	.0023	
28,776	200	.0239	.0167	
35,970	250	.0452	.0340	
43,164	300	.0691	.0531	
50,358	350	.0949	.0748	
57,552	400	.1205	.0959	Crack in one brick.
64,746	450	.1452	.1165	
71,940	500	.1757	.1429	
79,134	550	.1917	.1545	
86,328	600	.2277	.1858	E (100-600) = 597,000 pounds per square inch.
127,500	886	....	....	Ultimate strength.

Opened longitudinal cracks along middle of length of the pier. The pier was composed chiefly of half bricks at the end of the test.

No. 1623.

12″ COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's yard at East Brookfield, Mass.

Built of 37 courses of brick, with solid core.

Laid in neat Vulcanite Portland cement.

Age, 5 months 17 days.

Weight, 926 pounds = 109.7 pounds per cubic foot.

Height of pier, 96.20 inches.

Sectional area, 12″.26 × 12″.36 = 151.53 square inches.

Average thickness of joints, ″.30.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,153	100	0.	0.	Initial load. Loaded with 20,000 pounds before testing.
22,730	150	.0038	.0004	
30,306	200	.0083	.0013	
37,883	250	.0129	.0023	
45,459	300	.0179	.0034	Snapping sounds.
53,036	350	.0225	.0044	
60,612	400	.0273	.0058	
68,189	450	.0324	.0065	
75,765	500	.0369	.0071	
83,342	550	.0418	.0084	
90,918	600	.0470	.0092	Crack visible in one brick. E (100-600) = 661,000 pounds per square inch.
....	200	.0177	....	
....	300	.0258	....	
....	400	.0334	....	
....	500	.0405	....	
....	600	.0477	....	
....	500	.0418	....	
....	400	.0352	....	
....	300	.0279	....	
....	200	.0197	.0099	
98,495	650	.0524	....	
106,071	700	.0565	.0111	
113,648	750	.0616	....	
121,224	800	.0665	.0129	
128,801	850	.0720	....	
136,377	900	.0769	.0150	
143,954	950	.0830	....	
151,530	1,000	.0880	.0172	E (600-1,000) = 606,000 pounds per square inch.
....	200	.0265	....	
....	300	.0360	....	
....	400	.0448	....	
....	500	.0529	....	
....	600	.0609	....	
....	500	.0542	....	
....	400	.0468	....	
....	300	.0382	....	
....	200	.0284	.0172	
159,107	1,050	.0945	....	
160,700	1,061	....	....	Ultimate strength.

Opened longitudinal cracks in the lower half of the pier. Bricks in two courses spalled off.

No. 1635.

12" COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's yard at East Brookfield, Mass.

Built of 36 courses of brick, with solid core.

Laid in cement mortar—1 part Vulcanite cement and 3 parts sand.

Age, 6 months.

Weight, 912 pounds = 107.8 pounds per cubic foot.

Height of pier, 96.12 inches.

Sectional area, 12".42 × 12".24 = 152.02 square inches.

Average thickness of joints, ".35.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,202	100	0.	0.	Initial load. Loaded with 14,000 pounds before testing.
22,803	150	.0033	.0005	
30,404	200	.0070	.0010	
38,005	250	.0110	.0016	
45,606	300	.0155	.0022	
53,207	350	.0193	.0029	
60,808	400	.0234	.0035	
68,409	450	.0274	.0040	
76,010	500	.0316	.0046	
83,611	550	.0357	.0052	
91,212	600	.0402	.0060	E (100-600) = 731,000 pounds per square inch.
106,414	700	.0489	.0072	Snapping sounds.
121,616	800	.0581	.0088	
136,818	900	.0683	.0105	
152,020	1,000	.0785	.0125	E (600-1,000) = 629,000 pounds per square inch.
167,222	1,100	.0894	.0149	
182,424	1,200	.1030	.0179	
186,000	1,224	....	....	Ultimate strength.

Pier failed in the upper part by opening longitudinal cracks. A brick in the seventh course from the top crushed.

No. 1598.

12″ COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's yard at East Brookfield, Mass.

Built of 37 courses of brick, with solid core.

Laid in lime mortar—1 part lime and 3 parts sand.

Age, 24 days.

Weight, 868 pounds = 105.9 pounds per cubic foot.

Height of pier, 95.28 inches.

Sectional area, 12″.23 × 12″.16 = 148.72 square inches.

Average thickness of joints, ″.22.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,872	100	0.	0.	Initial load.
22,308	150	.0190	.0043	
29,744	200	.0900	.0790	E (100-200) = 455,000 pounds per square inch.
37,180	250	.1329	.1148	
44,616	300	.1986	.1744	E (200-300) = 379,000 pounds per square inch.
52,052	350	.2460	.2141	
59,488	400	.3085	.2697	E (300-400) = 342,000 pounds per square inch.
66,924	450	.3500	.3056	
69,200	465	....	....	Ultimate strength.

Opened cracks generally along the length of the pier, separating the bricks into halves.

No. 1624.

12″ COMMON BRICK PIER.

Hard, sand struck bricks from New England Brick Company's yard at Mechanicsville, N. Y.

Built of 37 courses of brick, with solid core.

Laid in neat Vulcanite Portland cement.

Age, 5 months 16 days.

Weight, 848 pounds = 106.4 pounds per cubic foot.

Height of pier, 95.57 inches.

Sectional area, 12″.01 × 12″.00 = 144.12 square inches.

Average thickness of joints, ″.26.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,412	100	0.	0.	Initial load. Loaded with 21,000 pounds before testing.
21,618	150	.0026	.0001	
28,824	200	.0055	.0008	
36,030	250	.0088	.0014	
43,236	300	.0118	.0020	
50,442	350	.0149	.0026	
57,648	400	.0180	.0031	
64,854	450	.0210	.0037	
72,060	500	.0240	.0042	Snapping sounds.
79,266	550	.0270	.0047	
86,472	600	.0301	.0054	E (100–600) = 1,012,000 pounds per square inch.
93,678	650	.0329	.0059	
100,884	700	.0360	.0066	
108,090	750	.0389	.0069	
115,296	800	.0421	.0075	
122,502	850	.0449	.0080	
129,708	900	.0484	.0091	
136,914	950	.0517	.0096	
144,120	1,000	.0550	.0103	E (600–1,000) = 1,000,000 pounds per square inch.
158,532	1,100	.0615	.0124	
172,944	1,200	.0680	.0130	
187,350	1,300	.0751	.0146	
201,768	1,400	.0847	.0185	Ultimate strength.

Maximum load reached after release to determine set, 198,000 pounds. Opened longitudinal cracks and spalled some of the bricks.

No. 1638.

12" COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's yard at Mechanicsville, N. Y.

Built of 36 courses of brick, with solid core.

Laid in cement mortar—1 part Vulcanite cement and 3 parts sand.

Age, 6 months.

Weight, 848 pounds = 103.8 pounds per cubic foot.

Height of pier, 95.75 inches.

Sectional area, 12".10 × 12".18 = 147.38 square inches.

Average thickness of joints, ".33.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,738	100	0.	0.	Initial load. Loaded with 14,000 pounds before testing.
22,107	150	.0022	.0004	
29,476	200	.0044	.0007	
36,845	250	.0068	.0009	
44,214	300	.0093	.0014	
51,583	350	.0118	.0018	
58,952	400	.0144	.0023	
66,321	450	.0167	.0026	
73,690	500	.0192	.0030	
81,059	550	.0217	.0033	
88,428	600	.0244	.0037	E (100-600) = 1,208,000 pounds per square inch.
103,166	700	.0293	.0042	
117,904	800	.0350	.0051	
132,642	900	.0401	.0057	
147,380	1,000	.0458	.0066	E (600-1,000) = 1,081,000 pounds per square inch.
162,118	1,100	.0520	.0076	
176,856	1,200	.0584	.0091	
191,594	1,300	.0653	.0103	Snapping sounds.
206,322	1,400	.0737	.0123	
208,000	1,411	....	....	Ultimate strength.

Pier failed near the upper end. Opened longitudinal cracks and crushed bricks in two courses.

No. 1626.

12″ COMMON BRICK PIER.

Hard, sand struck bricks from New England Brick Company's yard at Mechanicsville, N. Y.

Built of 37 courses of brick, with solid core.

Laid in lime mortar—1 part lime and 3 parts sand.

Age, 6 months.

Weight, 809 pounds = 99.8 pounds per cubic foot.

Height of pier, 94.50 inches.

Sectional area, 12″.25 × 12″.10 = 148.23 square inches.

Average thickness of joints, ″.23.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,823	100	0.	0.	Initial load. Loaded with 18,000 pounds before testing.
22,235	150	.0040	.0005	
29,646	200	.0179	.0101	
37,058	250	.0355	.0233	Snapping sounds
44,469	300	.0550	.0378	
51,881	350	.0737	.0514	Crack in 3d and 4th courses from the bottom.
59,292	400	.0967	.0699	
66,704	450	.1226	.0903	
74,115	500	.1449	.1078	
81,527	550	.1750	.1327	
88,938	600	.2009	.1536	E (100–600) = 529,000 pounds per square inch.
106,500	718	....	....	Ultimate strength.

Opened longitudinal lines of fracture, and faces of bricks spalled off in a number of courses.

TABULATION OF COMPRESSIVE TESTS OF BRICK PIERS.

Nominal dimensions 12″×12″×8 feet high.
Piers laid in neat Portland cement (Vulcanite brand), cement mortar, and lime mortar.
The hard and light-hard common were sand-struck bricks.

No. of test.	Description of bricks.	Pier laid in—	Age.		Weight per cubic foot.	Sectional area.	Compressive strength.		Moduli of elasticity between loads per square inch of—			Permanent set on gauged length of 50″ after loads in pounds per square inch of—		
							Total.	Per square inch.	100 and 600.	600 and 1,000.	1,000 and 2,000.	600.	1,000.	2,000
			Mos	*Days*	*Lbs.*	*Sq. ins.*	*Pounds.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Inch.*	*Inch.*
1594	Face, dry pressed	Neat cement	1		137.3	139.48	402,000	2,880	2,717,000	2,410,000	2,283,000	.0005	.0012	.0027
1637	do	1 cement, 3 sand	6		130.0	142.68	342,432	2,400	2,137,000	2,041,000	1,894,000	.0017	.0028	.0082
1628	do	1 lime, 3 sand	6		129.0	138.42	210,000	1,517	1,101,000	1,070,000		.0709	.1479	
1634	Face, repressed, mud bricks	Neat cement	5	23	124.4	144.96	279,000	1,925	1,190,000	1,105,000		.0048	.0086	
1625	do	1 cement, 3 sand	5	22	120.5	149.08	249,000	1,670	1,190,000	1,070,000		.0030	.0059	
1630	do	1 lime, 3 sand	6		120.5	143.76	181,100	1,260	689,000	673,000		.0821	.1925	
1599	Face, wire cut, mud bricks	1 cement, 2 sand		25	133.7	142.09	342,000	2,410	2,212,000	2,151,000	2,016,000	.0012	.0022	.0077
1636	do	Neat cement	5	23	133.6	141.49	569,000	4,021	2,381,000	2,273,000	2,165,000	.0015	.0025	.0056
1629	do	1 lime, 3 sand	6		130.3	138.53	196,700	1,420	1,064,000	1,163,000		.0886	.1761	
1596	Hard, West Cambridge, Mass	Neat cement	1		135.5	132.60	623,600	4,700	2,403,000	2,326,000	2,336,000	.0014	.0027	.0058
1597	do	1 cement, 3 sand	1		126.9	141.49	254,682	1,800	1,736,000	1,575,000		.0022	.0053	
1627	do	1 lime, 3 sand	5	27	123.8	130.64	129,900	994	806,000			.2437		
1595	Light-hard, West Cambridge, Mass	Neat cement	1		117.6	149.57	226,000	1,510	874,000	758,000		.0042	.0084	
1619	do	1 cement, 3 sand	6		111.6	142.09	215,800	1,519	1,012,000	881,000		.0025	.0051	
1631	do	1 lime, 3 sand	6		105.2	147.99	108,800	732	379,000			.2070		
[a] 1620	do	do	5	14	105.6	148.47	120,100	809						
1632	Hard, East Brookfield, Mass	Neat cement	5	20	116.6	147.01	289,500	1,969	1,029,000	1,047,000		.0060	.0095	
1633	do	1 cement 3 sand	6		114.0	147.62	265,716	1,800	1,295,000	1,176,000		.0021	.0042	
1622	do	1 lime, 3 sand	5	26	106.9	147.62	108,200	733	506,000			.1854		
[a] 1621	do	do	5	14	109.9	143.88	127,500	886	597,000			.1858		
1623	Light-hard, East Brookfield, Mass	Neat cement	5	17	109.7	151.53	160,700	1,061	661,000	606,000		.0092	.0172	
1635	do	1 cement, 3 sand	6		107.8	152.02	186,000	1,224	731,000	629,000		.0060	.0125	
1598	do	1 lime. 3 sand		24	105.9	148.72	69,200	465						
1624	Hard, Mechanicsville, N. Y	Neat cement	5	16	106.4	144.12	201,768	1,400	1,012,000	1,000,000		.0054	.0103	
1638	do	1 cement, 3 sand	6		103.8	147.38	208,000	1,411	1,208,000	1,081,000		.0037	.0066	
1626	do	1 lime, 3 sand	6		99.8	148.23	106,500	718	529,000			.1536		

[a] Panels of bricks filled with neat Portland cement.

BRICKS.

COMPRESSION TESTS OF BRICKS.

Representing the materials used in brick piers for the Louisiana Purchase Exposition, and other investigative piers.

Compressed surfaces set in neat Portland cement.

DRY PRESSED BRICK FROM THE PHILADELPHIA AND BOSTON FACE BRICK COMPANY.

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
D P 1	2.22	3.94	7.89	31.09	312,000	317,500	10,210
D P 2	2.22	3.92	7.88	30.89	273,000	276,000	8,930
D P 3	2.21	3.89	7.82	30.42	281,000	294,100	9,670
D·P 4	2.18	3.75	7.71	28.91	423,000	520,000	17,990
D P 5	2.22	3.88	7.86	30.50	279,000	279,000	9,150

REPRESSED BRICK FROM THE NEW ENGLAND BRICK COMPANY.

R P 1	2.27	3.88	8.00	31.04	146,000	234,600	7,560
R P 2	2.37	3.86	8.08	31.19	179,000	203,000	6,510
R P 3	2.30	3.95	8.12	32.07	157,000	214,500	6,690
R P 4	2.29	3.92	8.09	31.72	169,000	183,000	5,770
R P 5	2.24	3.96	8.09	32.04	156,000	236,000	7,370

WIRE-CUT BRICK FROM MESSRS. FISKE & CO.

W C 1	2.30	3.67	7.86	28.85	225,000	399,800	13,860
W C 2	2.30	3.68	7.92	29.15	271,000	426,000	14,610
W C 3	2.25	3.72	7.90	29.39	248,000	450,500	15,330
W C 4	2.38	3.70	8.01	29.64	238,000	329,000	11,100
W C 5	2.37	3.80	8.10	30.78	254,000	275,000	8,930

HARD, SAND-STRUCK BRICK FROM NEW ENGLAND BRICK COMPANY'S YARD NO. 5, WEST CAMBRIDGE, MASS.

C H 1	2.21	3.53	7.75	27.36	168,000	323,000	11,810
C H 2	2.25	3.55	7.71	27.37	104,000	297,200	10,860
C H 3	2.25	3.57	7.85	28.02	235,000	284,000	10,140
C H 4	2.25	3.62	7.80	28.56	118,000	261,000	9,140
C H 5	2.21	3.43	7.55	25.90	195,000	382,000	14,750

LIGHT HARD, SAND-STRUCK BRICK FROM NEW ENGLAND BRICK COMPANY'S YARD NO. 5, WEST CAMBRIDGE, MASS.

C LH 1	2.28	3.70	7.99	29.56	96,000	231,000	7,810
C LH 2	2.29	3.68	7.99	29.40	104,000	252,500	8,590
C LH 3	2.31	3.68	8.02	29.51	68,000	199,800	6,770
C LH 4	2.33	3.74	8.09	30.26	99,000	139,600	4,610
C LH 5	2.40	3.78	8.23	31.11	112,000	162,000	5,210

HARD, SAND-STRUCK BRICK FROM NEW ENGLAND BRICK COMPANY'S YARD AT EAST BROOKFIELD, MASS.

B H 1	2.29	3.60	8.15	29.34	143,000	201,000	6,850
B H 2	2.30	3.67	8.22	30.17	72,000	158,000	5,240
B H 3	2.36	3.60	8.29	29.84	90,000	158,200	5,300
B H 4	2.28	3.65	8.40	30.66	110,000	142,500	4,650
B H 5	2.38	3.60	8.43	30.35	108,000	127,500	4,200

COMPRESSION TESTS OF BRICKS—Continued.

LIGHT HARD, SAND-STRUCK BRICK FROM NEW ENGLAND BRICK COMPANY'S YARD AT EAST BROOKFIELD, MASS.

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
B LH 1	2.28	3.66	8.27	30.27	79,000	135,000	4,460
B LH 2	2.30	3.70	8.29	30.67	121,000	133,000	4,340
B LH 3	2.35	3.68	8.29	30.51	66,000	135,100	4,430
B LH 4	2.26	3.69	8.31	30.66	120,000	139,900	4,560
B LH 5	2.31	3.70	8.38	31.01	114,000	142,000	4,580

HARD, SAND-STRUCK BRICK FROM NEW ENGLAND BRICK COMPANY'S YARD AT MECHANICSVILLE, N. Y.

M H 1	2.27	3.53	8.06	28.45	112,000	184,000	6,470
M H 2	2.30	3.57	8.12	28.99	140,000	195,000	6,730
M H 3	2.31	3.68	8.16	30.03	101,000	158,500	5,280
M H 4	2.29	3.62	8.15	29.50	69,000	150,600	5,110
M H 5	2.30	3.67	8.20	30.09	92,000	164,000	5,450

TESTS OF BRICKS.

ABSORPTION OF WATER.

Bricks immersed in water 5 months.

Marks.	Description.	Dimensions.			Panels.	Volume.		Weight.				Gain.			Weight per cubic foot of the dry brick.
		Height.	Compressed surface.					Before immersion.		After immersion.		Total.	By weight.	By volume	
		Inches.	*Inches.*	*Inches.*		*Cu. ins.*	*Cu. ft.*	*Lbs.*	*Ozs.*	*Lbs.*	*Ozs.*	*Ozs.*	*P. ct.*	*P. ct.*	*Pounds.*
D P......	Dry pressed, Philadelphia and Boston.	2.22	3.94	7.89	None.	69.01	.040	5	4.00	5	11.25	7.25	8.63	18.07	131.25
R P......	Repressed, New England Brick Company.	2.28	3.90	8.13	None.	72.29	.042	5	2.75	5	12.50	9.75	11.78	23.38	123.14
W C.....	Wire cut, face	2.23	3.66	7.88	None.	64.31	.037	5	4.75	5	8.00	3.25	3.83	8.61	143.16
C H......	Hard, West Cambridge..........	2.21	3.40	7.56	5″.5 by 1″.8 by ″.11	55.72	.032	4	9.75	4	11.25	1.50	2.03	4.47	144.03
C LH....	Light hard, West Cambridge ...	2.30	3.76	7.88	5″.45 by 2″.0 by ″.11	66.95	.039	4	6.75	5	1.50	10.75	15.19	27.72	113.38
B H.....	Hard, East Brookfield...........	2.30	3.58	8.27	5″.80 by 1″.9 by ″.08	67.21	.039	4	5.25	4	15.75	10.50	15.16	27.20	110.97
B LH....	Light hard, East Brookfield....	2.24	3.66	8.28	5″.80 by 1″.9 by ″.10	66.78	.039	4	4.25	4	15.75	11.50	16.85	29.86	109.38
M H.....	Hard, Mechanicsville............	2.34	3.64	8.16	5″.80 by 2″.0 by ″.10	68.34	.040	4	0.50	4	14.25	13.75	21.32	34.86	100.78

SAND-LIME BRICK.

Bricks made in Prescott, Ariz., by the Huennekes system, and used by the Constructing Quartermaster in the Whipple Barracks, Prescott, Ariz.; also bricks from the Quartermaster, United States Army, West Point, N. Y.

COMPRESSION TESTS OF BRICKS FOR THE CONSTRUCTING QUARTERMASTER, UNITED STATES ARMY, WHIPPLE BARRACKS, ARIZ.

Brick made in Prescott, Ariz., by the Huennekes system (sand and lime) and called "sandstone" brick.

Compressed surfaces faced with plaster of Paris to secure even bearings in the testing machine.

Dimensions.			Sectional area.	First crack.	Ultimate strength.	
Height.	Compressed surface.				Total.	Per square inch.
Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
2.27	4.13	8.43	34.82	99,500	111,900	3,210
2.27	4.13	8.43	34.82	88,500	99,000	2,840
[a]2.28	4.13	4.26	17.59	45,800	51,900	2,950

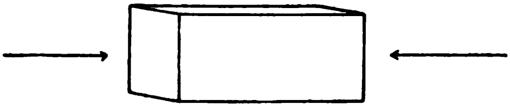
[a] Half-brick.

ABSORPTION OF WATER.

Brick immersed in water 1 week.
Absorption, by weight, 12.35 per cent.

ELASTIC PROPERTIES.

No. 1545.



"Sandstone brick" (sand and lime).
Weight per cubic foot, 115.5 pounds.
Dimensions: 2".28 by 4".13 by 8".43.
Sectional area, 9.42 square inches.
Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
942	100	0.	0.	Initial load.
1,884	200	.0004	....	
2,826	300	.0009	....	
3,768	400	.0014	....	
4,710	500	.0020	.0005	
5,652	600	.0025	....	
6,594	700	.0031	....	
7,536	800	.0038	....	
8,478	900	.0045	....	
9,420	1,000	.0053	.0015	
10,362	1,100	.0061	....	
11,304	1,200	.0072	....	
12,246	1,300	.0085	....	
13,188	1,400	.0105	....	
14,130	1,500	.0152	.0074	
14,200	1,510	....	....	Ultimate strength.

COMPRESSION TESTS OF HALF BRICKS FOR THE QUARTERMASTER, UNITED STATES ARMY, WEST POINT, N. Y.

Sand-lime bricks made by the Huennekes system, and one controlled by the W. A. Underhill Company.

Marks.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
1	2.37	4.27	4.25	18.15	67,000	73,500	4,050
2	2.28	4.08	4.12	16.81	58,200	60,900	3,620
3	2.27	4.08	4.12	16.81	49,500	49,500	2,940
4	2.21	4.13	4.30	17.76	69,900	75,700	4,260
HALF BRICKS, TESTED WHEN WET, AFTER 16½ HOURS IMMERSION.							
2a	2.27	4.07	4.13	16.81	42,800	43,780	2,600
4a	2.19	4.13	4.21	17.39	60,500	61,360	3,530
PIECES OF ONE-FOURTH BRICKS TESTED AFTER EXPOSURE OF 2 HOURS OVER A WOOD FIRE.							
1a	2.34	2.06	3.06	6.30	....	4,570	725
3a	2.29	2.00	4.17	8.34	....	6,240	748

When fragments of the bricks, in the state received for testing, were treated with hydrochloric acid there was a rapid effervescence, disengaging copious quantities of carbon dioxide. After heating and testing the fragments of bricks 1a and 3a were treated with acid. At this time little or no gas was disengaged.

ABSORPTION OF WATER.

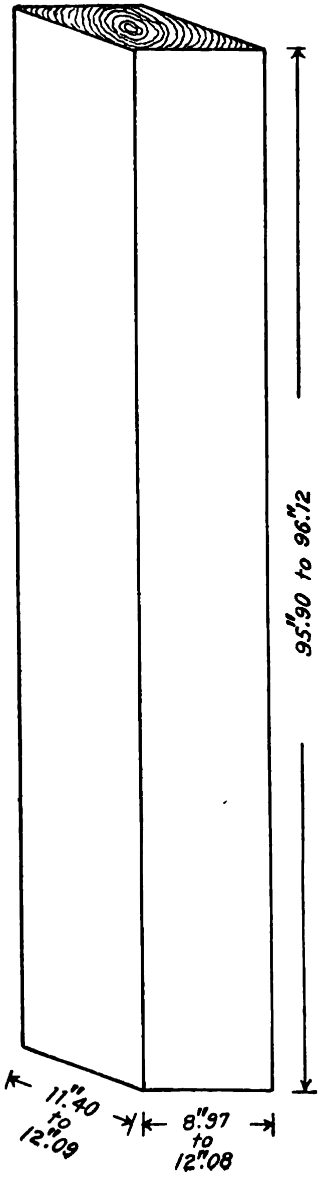
Specimens were immersed in water 16½ hours.

Marks.	Weight.					Absorption.	
	Before immersion.		After immersion.		Gain.	By weight.	By volume.
	Pounds.	*Ounces.*	*Pounds.*	*Ounces.*	*Ounces.*	*Per cent.*	*Per cent.*
2a	2	8.0	2	13.5	5.5	13.8	25.0
4a	2	11.0	2	14.0	3.0	7.0	13.7

WOODEN POSTS.

Material, in part, exhibited at the Louisiana Purchase Exposition, St. Louis, Mo., 1904.

WOODEN POSTS.



No. 1586.

Basket-oak post.
Weight, 428 pounds = 52.8 pounds per cubic foot.
Moisture, 35.76 per cent.
Average rate of growth, 25 rings per inch.
Height, 96.02 inches.
Sectional area, 12".09 × 12".08 = 146.05 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,605	100	0.	0.	Initial load.
29,210	200	.0045	0. +	
43,815	300	.0090	.0002	
54,420	400	.0130	.0003	
73,025	500	.0173	....	
87,630	600	.0212	.0008	
102,235	700	.0258	....	
116,840	800	.0301	.0013	
131,445	900	.0343	....	
146,050	1,000	.0388	.0018	E (100-1,000) = 1,216,000 pounds per square inch.
175,260	1,200	.0473	....	
204,470	1,400	.0569	.0028	
233,680	1,600	.0670	....	
262,890	1,800	.0772	.0047	
292,100	2,000	.0893	.0055	E (1,000-2,000) = 1,068,000 pounds per square inch.
321,310	2,200	.1057	....	
350,520	2,400	.1302	.0122	
379,730	2,600	.1697	.0206	
408,940	2,800	.35	....	
431,000	2,950	....	....	Ultimate strength.

Fibers crushed at a knot about 2" diameter near the middle of the length of the post. The post deflected laterally in a downward direction at the middle. The loads were continued until the fibers crushed near each end, a result incident to the flexure.

No. 1589.

Long-leaf pine post (butt).
Weight, 355 pounds = 45.5 pounds per cubic foot.
Moisture, 26.90 per cent.
Average rate of growth, 14 rings per inch.
Height, 96 inches.
Sectional area, 11″.85 × 11″.82 = 140.07 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,007	100	0.	0.	Initial load.
28,014	200	.0023	0.	
42,021	300	.0042	0.	
56,028	400	.0063	0.	
70,035	500	.0083	....	
84,042	600	.0103	0.	
98,049	700	.0123	....	
112,056	800	.0143	0.	Remained under 40,000 pounds load 16 hours.
126,063	900	.0165	....	
140,070	1,000	.0187	0.	E (100-1,000) = 2,406,000 pounds per square inch.
168,084	1,200	.0230	....	
196,098	1,400	.0274	0.	
224,112	1,600	.0322	....	
252,126	1,800	.0366	0.	
280,140	2,000	.0413	0.	E (1,000-2,000) = 2,212,000 pounds per square inch.
308,154	2,200	.0460	....	
336,168	2,400	.0510	.0001	
364,182	2,600	.0558	....	
392,196	2,800	.0608	.0003	
420,210	3,000	.0658	.0004	E (2,000-3,000) = 2,075,000 pounds per square inch.
448,224	3,200	.0708	....	
476,238	3,400	.0763	.0010	
504,252	3,600	.0819	....	
532,266	3,800	.0887	.0015	
560,280	4,000	.0965	.0022	E (3,000-4,000) = 1,730,000 pounds per square inch.
588,294	4,200	.1078	....	
616,308	4,400	....	....	Ultimate strength.

Fibers crushed at one end, and also near the middle of the length of the post.

No. 1588.

Long-leaf pine post (top).
Weight, 322 pounds = 41.8 pounds per cubic foot.
Moisture, 18.83 per cent.
Average rate of growth, 14 rings per inch.
Height, 96.12 inches.
Sectional area, 11″.70 × 11″.88 = 139 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,900	100	0.	0.	Initial load
27,800	200	.0034	.0001	
41,700	300	.0065	.0003	
55,600	400	.0094	.0003	
69,500	500	.0124	....	
83,400	600	.0154	.0005	
97,300	700	.0183	....	
111,200	800	.0212	.0005	
125,100	900	.0243	....	
139,000	1,000	.0272	.0007	E (100-1,000) = 1,698,000 pounds per square inch.
166,800	1,200	.0331	....	
194,600	1,400	.0393	.0010	
222,400	1,600	.0452	....	
250,200	1,800	.0515	.0015	
278,000	2,000	.0584	.0023	E (1,000-2,000) = 1,689,000 pounds per square inch.
305,800	2,200	.0646	....	
333,600	2,400	.0709	.0028	
361,400	2,600	.0777	....	
389,200	2,800	.0846	.0035	
417,000	3,000	.0927	.0044	E (2,000-3,000) = 1,553,000 pounds per square inch.
444,800	3,200	.1030	....	
472,600	3,400	.1163	.0084	
500,400	3,600	.1413	....	
502,000	3,610	....	....	Ultimate strength.

Fibers crushed in the vicinity of a knot 2″ diameter, located 2 feet from the end of the post.

No. 1592.

Short-leaf pine post (butt).
Weight, 340 pounds = 45.9 pounds per cubic foot.
Moisture, 30.67 per cent.
Average rate of growth, 5 rings per inch.
Height, 96 inches.
Sectional area, 11″.40 × 11″.69 = 133.27 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,327	100	0.	0.	Initial load.
26,654	200	.0025	0.	
39,981	300	.0056	0.	
53,308	400	.0089	−.0001	Minus sets are attributed to temperature change in testing room.
66,635	500	.0123	....	
79,962	600	.0155	−.0002	
93,289	700	.0189	....	
106,616	800	.0225	−.0002	
119,943	900	.0259	....	
133,270	1,000	.0299	−.0002	E (100-1,000) = 1,495,000 pounds per square inch.
159,924	1,200	.0365	....	
186,578	1,400	.0439	−.0001	
213,232	1,600	.0509	....	
239,886	1,800	.0585	0.	
266,540	2,000	.0656	+.0001	E (1,000-2,000) = 1,412,000 pounds per square inch.
293,194	2,200	.0730	....	
319,848	2,400	.0810	.0004	
346,502	2,600	.0897	....	
373,156	2,800	.0983	.0017	
399,810	3,000	.1085	.0024	E (2,000-3,000) = 1,232,000 pounds per square inch.
426,464	3,200	.1187	....	
453,118	3,400	.1332	.0044	
479,772	3,600	.1570	....	
504,000	3,780	....	....	Ultimate strength.

Fibers crushed in oblique lines from 0″ to 14″ from the end of the post.

No. 1593.

Short-leaf pine post (top).
Weight, 317.5 pounds = 42.3 pounds per cubic foot.
Moisture, 41.93 per cent.
Average rate of growth, 5 rings per inch.
Height, 96.05 inches.
Sectional area, 11″.53 × 11″.63 = 134.09 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,409	100	0.	0.	Initial load.
26,818	200	.0034	0.	
40,227	300	.0071	0.	
53,636	400	.0110	.0002	
67,045	500	.0146	....	
80,454	600	.0183	.0006	
93,863	700	.0221	....	
107,272	800	.0258	.0008	
120,681	900	.0295	....	
134,090	1,000	.0333	.0012	E (100–1,000) = 1,402,000 pounds per square inch.
160,908	1,200	.0407	....	
187,720	1,400	.0482	.0018	
214,544	1,600	.0562	....	
241,362	1,800	.0639	.0026	
268,180	2,000	.0722	.0028	E (1,000–2,000) = 1,340,000 pounds per square inch.
294,998	2,200	.0807	....	
321,816	2,400	.0898	.0038	
348,634	2,600	.1001	....	
375,452	2,800	.1117	.0053	
402,270	3,000	.1345	.0080	E (2,000–3,000) = 876,000 pounds per square inch.
406,000	3,030	....	....	Ultimate strength.

Fibers crushed at a knot 1″ diameter, 2′ 9″ from the end of the post.

No. 1590.

Spruce post.
Weight, 236.5 pounds = 29.9 pounds per cubic foot.
Moisture, 42.27 per cent.
Average rate of growth, 15 rings per inch.
Height, 95.90 inches.
Sectional area, 11".86 × 11".87 = 140.78 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,078	100	0.	0.	Initial load.
22,156	200	.0034	0.	
42,234	300	.0067	0.	
56,312	400	.0101	.0001	
70,390	500	.0137	....	
84,468	600	.0173	.0002	
98,546	700	.0209	....	
112,624	800	.0247	.0002	
126,702	900	.0283	....	
140,780	1,000	.0321	.0003	E(100-1,000) = 1,416,000 pounds per square inch.
168,936	1,200	.0398	....	
197,092	1,400	.0474	.0007	
225,248	1,600	.0552	....	
253,404	1,800	.0631	.0012	
281,560	2,000	.0715	.0016	E (1,000-2,000) = 1,312,000 pounds per square inch.
309,716	2,200	.0818	....	
337,872	2,400	.0958	.0042	
366,028	2,600	.1213	....	
392,000	2,780	....	....	Ultimate strength.

Fibers crushed 3" to 12" from end of post.

No. 1587.

Douglas fir post.

Retest of post reported in Tests of Metals, 1895, page 548. Portion of the post which had been crushed in earlier test was cut off.

Weight, 204 pounds = 31.9 pounds per cubic foot.

Moisture, 11.30 per cent.

Average rate of growth, 15 rings per inch.

Height, 96.10 inches.

Sectional area, 9″.87 × 11″.67 = 115.18 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,518	100	0.	0.	Initial load.
23,036	200	.0026	0.	
34,554	300	.0050	.0002	
46,072	400	.0073	.0003	
57,590	500	.0097	....	
69,108	600	.0120	.0003	
80,626	700	.0142	....	
92,144	800	.0166	.0003	
103,662	900	.0189	....	
115,180	1,000	.0213	.0003	E(100-1,000) = 2,143,000 pounds per square inch.
138,216	1,200	.0258	....	
161,252	1,400	.0306	.0005	
184,288	1,600	.0353	....	
207,324	1,800	.0401	.0007	
230,360	2,000	.0446	.0008	E (1,000-2,000) = 2,193,000 pounds per square inch.
253,396	2,200	.0497	....	
276,432	2,400	.0544	.0012	
299,468	2,600	.0598	....	
322,504	2,800	.0647	.0014	
345,540	3,000	.0698	.0015	E (2,000-3,000) = 2,041,000 pounds per square inch.
368,576	3,200	.0752	....	
391,612	3,400	.0803	.0021	
414,648	3,600	.0854	....	
437,684	3,800	.0908	.0028	
460,720	4,000	.0961	.0033	E (3,000-4,000) = 2,041,000 pounds per square inch.
483,756	4,200	.1015	....	
506,792	4,400	.1076	.0042	
529,828	4,600	.1133	....	
552,864	4,800	.1188	.0052	
575,900	5,000	.1250	.0060	E (4,000-5,000) = 1,908,000 pounds per square inch.
598,936	5,200	.1307	....	
621,972	5,400	.1370	.0077	
732,000	6,360	....	....	Ultimate strength.

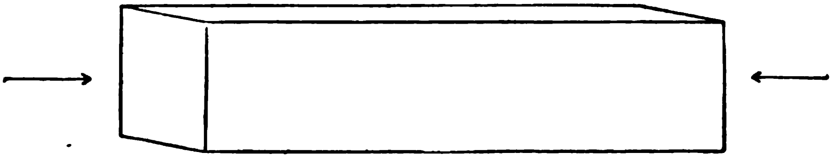
Fibers crushed 32″ from end of post.

PHILIPPINE AND JAPANESE WOODS.

Philippine Woods.

Names of woods represented: Acle, Yacal, Ipil, and Guijo.

COMPRESSION TESTS.



No. 1541.

Name, Acle.
Weight per cubic foot, 67.5 pounds.
Color, dark brown.
Ends of stick slightly checked.
Dimensions, 4″.06 × 6″.02 × 23″.80.
Sectional area, 24.44 square inches.
Gauged length, 10″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,444	100	0.	0.	Initial load.
4,888	200	.0005	....	
7,332	300	.0009	....	
9,776	400	.0015	....	
14,664	600	.0025	....	
19,552	800	.0039	....	
24,440	1,000	.0050	0.	
36,600	1,500	.0080	....	
48,880	2,000	.0111	0.	
61,100	2,500	.0144	....	
73,320	3,000	.0176	.0002	
85,540	3,500	.0207	....	
97,760	4,000	.0242	.0005	E (1,000–4,000)=1,604 000 pounds per square inch.
109,980	4,500	.0295	....	
122,200	5,000	.0450	.0060	
126,000	5,160	....	....	Ultimate strength.

Fibers crushed 10″ from end.
Sap ran out of wood at place of fracture.

No. 1542.

Name, Yacal.
Weight per cubic foot, 63.1 pounds.
Color, medium brown.
Ends of stick checked badly in radial lines.
Dimensions, 4″.01 × 5″.96 × 23″.80.
Sectional area, 23.90 square inches.
Gauged length, 10″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,390	100	0.	0.	Initial load.
4,780	200	.0002	....	
9,560	400	.0005	....	
14,340	600	.0009	....	
19,120	800	.0014	....	
23,900	1,000	.0020	0.	
35,850	1,500	.0039	....	
47,800	2,000	.0050	.0001	
59,750	2,500	.0066	....	
71,700	3,000	.0082	.0002	
83,650	3,500	.0098	....	
95,600	4,000	.0115	.0003	E (1,000–4,000)=3,261,000 pounds per square inch.
107,550	4,500	.0132	....	
119,500	5,000	.0151	.0005	
131,450	5,500	.0174	....	
143,400	6,000	.0205	.0007	
155,350	6,500	.0243	....	
167,300	7,000	.0410	.0064	Ultimate strength.

Fibers crushed in an oblique course near end of stick.

No. 1543.

Name, Ipil.
Weight per cubic foot, 60.2 pounds.
Color, dark reddish brown.
Somewhat checked at ends.
Dimensions, 4″.02 × 6″.00 × 23″.74.
Sectional area, 24.12 square inches.
Gauged length, 10″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,412	100	0.	0.	Initial load.
4,824	200	.0004	....	
9,648	400	.0011	....	
14,472	600	.0020	....	
19,296	800	.0029	....	
24,120	1,000	.0039	.0001	
36,180	1,500	.0066	....	
48,240	2,000	.0092	.0001	
60,300	2,500	.0119	....	
72,360	3,000	.0150	.0002	
84,420	3,500	.0187	....	
96,480	4,000	.0229	.0010	E (1,000-4,000)=1,657,000 pounds per square inch.
108,540	4,500	0276	....	
120,600	5,000	.0324	.0033	
132,660	5,500	.0380	....	
144,720	6,000	.0441	.0049	
156,780	6,500	.0524	....	
168,840	7,000	.0624	.0089	
180,900	7,500	.0805	.0145	Ultimate strength.

Fibers crushed in oblique lines near middle of length, in vicinity of small knots.

No. 1544.

Name, Guijo.
Weight per cubic foot, 56 pounds.
Color, reddish brown.
Checked at ends and along its length.
Dimensions, 3″.98 × 5″.98 × 23″.80.
Sectional area, 23.80 square inches.
Gauged length, 10″.

Applied loads.		In gauged length.		Remarks
Total.	Per square inch.	Compression.	Set.	
Pounds	*Pounds.*	*Inch.*	*Inch.*	
2,380	100	0.	0.	Initial load.
4,760	200	.0004	....	
9,520	400	.0011	....	
14,280	600	.0019	....	
19,040	800	.0028	....	
23,800	1,000	.0037	.0002	
35,700	1,500	.0056	....	
47,600	2,000	.0079	.0002	
59,500	2,500	.0100	....	
71,400	3,000	.0121	.0003	
83,300	3,500	.0145	....	
95,200	4,000	.0169	.0005	E (1,000–4,000)=2,326,000 pounds per square inch.
107,100	4,500	.0192	....	
119,000	5,000	.0218	.0008	
130,900	5,500	.0250	....	
142,800	6,000	.0290	.0019	
154,700	6,500	.0365	....	
159,900	6,720	....	....	Ultimate strength.

Fibers crushed near the end of the stick.

TRANSVERSE TESTS.

Sticks loaded at the middle and supported at the ends, 42" apart.

No. of test.	Name of wood.	Dimensions.			Weight.		Ultimate strength.	
		Length over all.	Depth.	Width.	Total.	Per cubic foot.	Total.	Modulus of rupture per square inch.
		Inches.	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
743	Acle	48.05	4.04	2.04	13.75	60.0	5,840	11,050
744	Yacal...........	48.08	3.95	1.96	13.00	60.5	8,120	16,730
745	Ipil.............	48.05	3.99	2.00	12.00	54.1	5,900	11,670
746	Guijo...........	48.06	3.96	1.98	11.75	53.9	7,640	15,500

DETAILS OF TESTS.

Applied loads.	Deflection of sticks at middle of length.				Remarks.
	Acle.	Yacal.	Ipil.	Guijo.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
500	0.	0.	0.	0.	Initial load.
1,000	.0400	.0247	.0454	.0290	
1,500	.0863	.0504	.0910	.0595	
2,000	.1325	.0759	.1384	.0915	
2,500	.1756	.1016	.1870	.1219	
3,000	.2227	.1285	.2380	.1539	
500	.0080	.0053	.0138	.0058	
3,500	.2708	.1560	.2889	.1859	
4,000	.3257	.1847	.3450	.2191	
4,500	.3835	.2127	.4000	.2510	
500	.0376	....	.0404	.0143	
5,000	....	.2415	.4620	.2862	
500	....	.0155	....	....	
5,500	....	.2765	.5381	.3258	
6,000	....	.3177	....	.3718	
6,500	....	.3830	....	.4256	
7,000	....	.4930	....	....	
500	....	.0960	....	....	

REMARKS.

Acle.—Under 4,500 pounds load a splintering fracture began on the tension side of the stick 6¼" from the middle, at the corner of the stick. Long, splintering fracture on the tension side at time of reaching maximum load. Fibers indented on compression side ".03 under bearing surface of plunger 1½" by 2".

Yacal.—Fine, splintering fracture on the tension side. Split along the grain three-fourths the length of the stick. Fibers indented on compression side ".10 under bearing surface of plunger 1½" by 2".

Ipil.—Short, brittle fracture on the tension side 4¾" from the middle of length of stick.

Guijo.—This sample contained a number of worm holes ".03 diameter. Fine, splintering fracture on the tension side. Fibers indented on the compression side ".05 under bearing surface of plunger 1½" by 2".

MOISTURE DETERMINATIONS.

Cross sections about 1″ long each were cut from compression specimens after testing, alongside the fractured parts, and immediately weighed. They were then heated in a muffle at 212 degrees F. until the moisture was expelled and a constant weight reached.

The muffle furnace was run 8 hours per day, and 6 days were required to bring the samples to a constant weight. Each wood checked while drying, the Acle least, the Yacal most, the Ipil and Guijo showing intermediate effects.

Name of wood.	Weight of samples.		Loss.	
	Before drying.	After drying.	In weight.	Per cent.
	Grains.	*Grains.*	*Grains.*	
Acle	7,180	4,620	2,560	35.65
Yacal	6,405	4,807	1,598	24.94
Ipil	5,750	4,520	1,230	21.39
Guijo	5,750	4,528	1,222	21.35

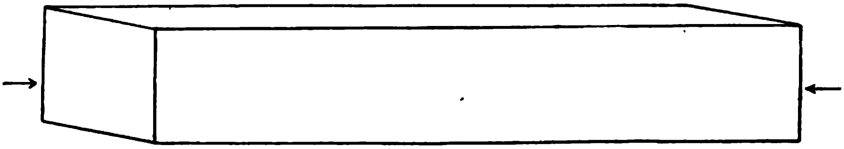
The sections after drying were distorted as well as checked and shrunk considerably in sectional area. The approximate changes in cross-sectional areas were as follows:

Name of wood.	Sectional areas.		
	Before drying.	After drying.	Difference.
	Sq. inches.	*Sq. inches.*	*Sq. inches.*
Acle	24.44	21.96	2.48
Yacal	23.90	19.28	4.62
Ipil	24.12	22.45	1.67
Guijo	23.80	21.37	2.43

JAPANESE WOODS.

Names of woods represented, Keyaki and Kashi. Identification not furnished.

COMPRESSION TESTS.



No. 1600.

Marks, No. 1.
Dimensions, 3".47 × 3".47 × 19".80.
Sectional area, 12.04 square inches.
Gauged length, 10".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,204	100	0.	0.	Initial load.
2,408	200	.0005	....	
3,612	300	.0010	....	
4,816	400	.0015	....	
7,224	600	.0024	....	
9,632	800	.0033	....	
12,040	1,000	.0043	.0001	
18,160	1,500	.0069	....	
24,080	2,000	.0094	.0001	
30,100	2,500	.0119	....	
36,120	3,000	.0148	.0004	
42,140	3,500	.0171	....	
48,160	4,000	.0205	.0010	E (1,000-4,000) = 1,961,000 pounds per square inch.
54,180	4,500	.0232	....	
60,200	5,000	.0277	.0022	
66,220	5,500	.0334	....	
72,240	6,000	.0375	.0044	
78,260	6,500	.0469	....	
84,280	7,000	.0572	.0120	
95,400	7,920	....	....	Ultimate strength.

Split along the grain obliquely from end to end, dividing the specimen into nearly equal parts. The smaller piece was suddenly detached and violently flew from the testing machine.

No. 1601.

Marks, No. 2.
Dimensions, 3″.47 × 3″.48 × 19″.72.
Sectional area, 12.08 square inches.
Gauged length, 10″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,208	100	0.	0.	Initial load.
2,416	200	.0005	....	
3,624	300	.0009	....	
4,832	400	.0012	....	
7,248	600	.0019	....	
9,664	800	.0027	....	
12,080	1,000	.0035	.0001	
18,120	1,500	.0052	....	
24,160	2,000	.0072	.0002	
30,200	2,500	.0093	....	
36,240	3,000	.0114	.0003	
42,280	3,500	.0135	....	
48,320	4,000	.0156	.0006	E (1,000-4,000)=2,586,000 pounds per square inch.
54,360	4,500	.0176	....	
60,400	5,000	.0202	.0013	
66,440	5,500	.0234	....	
72,480	6,000	.0271	.0029	
78,520	6,500	.0312	....	
84,560	7,000	.0352	.0054	
102,100	8,450	....	....	Ultimate strength.

Fibers crushed near the end of the stick, taking an oblique course in a crosswise direction.

TRANSVERSE TESTS.

Names of woods, "Keyaki" and "Kashi." Identification not furnished.

Sticks supported at the ends 42″ apart and loaded at the middle with plunger having a face 1″ long.

Average rate of growth: Rings per inch, No. 750, 13; No. 751, 8.

No. of test.	Dimensions.			Weight.		Ultimate strength.	
	Length over all.	Depth.	Width.	Total.	Per cubic foot.	Total.	Modulus of rupture per square inch.
	Inches.	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
750	48.01	2.00	3.33	10.56	57.1	7,050	20,020
751	48.03	1.98	3.36	9.81	53.0	6,620	18,660

DETAILS OF TESTS.

Applied loads.	Deflections at middle of length.	
	No. 750.	No. 751.
Pounds.	*Inch.*	*Inch.*
500	0.	0.
1,000	.0525	.0595
1,500	.1027	.1176
2,000	.1547	.1765
500	.0040	.0081
2,500	.2065	.2381
3,000	.2590	.3000
500	.0079	.0165
3,500	.3130	.3712
4,000	.3715	.4580
500	.0150	.0477
4,500	.4248	.4477
5,000	.5077	.6830
500	.0338	.1095
5,500	.5873	.8225
6,000	.7250	1.0050
500	.0940	.2381

REMARKS.

No. 750. Fine, splintering fracture on the tension side. Fibers indented on the compression side ″.02.

No. 751. Fine, splintering fracture on the tension side. Fibers indented on the compression side ″.05.

Moduli of elasticity between loads of 500 and 2,000 pounds: No. 750, 2,433,000 pounds per square inch; No. 751, 2,095,000 pounds per square inch.

MOISTURE DETERMINATIONS.

No. of test.	Weight of samples.		Loss.	
	Before drying.	After drying.	In weight.	Per cent.
	Grains.	*Grains.*	*Grains.*	
750	1,650	1,465	185	11.2
751	1,600	1,440	160	10.0

TENSILE TESTS OF TRACING CLOTH FOR THE ORDNANCE DEPARTMENT, UNITED STATES ARMY.

Marks, "Koh-i-noor," "Excelsior," "Imperial 4," and "Imperial 24."

Length of specimens over all, 5".

Length between jaws of testing machine, 3".

Width between jaws of testing machine, 1".

The cloth was tested in two ways. Warp or filling not identified as such.

"KOH-I-NOOR." THICKNESS, ".0030.

One way.			Other way.	
No. of specimen.	First test.	Second test.	No. of specimen.	First test.
	Pounds.	*Pounds.*		*Pounds.*
1	47	47	1	25
2	52	53	2	25
3	57	54	3	23

"EXCELSIOR." THICKNESS, ".0029.

One way.		Other way.		
No. of specimen.	First test.	No. of specimen.	First test, straight.	Second test, oblique.
	Pounds.		*Pounds.*	*Pounds.*
1	49	1	15	19
2	45	2	15½	18½
3	54	3	19	20

"IMPERIAL 4." THICKNESS, ".0030.

One way.		Other way.	
No. of specimen.	First test.	No. of specimen.	First test.
	Pounds.		*Pounds.*
1	55	1	27
2	56½	2	26½
3	53	3	26½

"IMPERIAL 24." THICKNESS, ".0026.

One way.		Other way.	
No. of specimen.	First test.	No. of specimen.	First test.
	Pounds.		*Pounds.*
1	44	1	26
2	42	2	25
3	46½	3	25½

PRIVATE TESTS.

TESTS MADE FOR PRIVATE PARTIES DURING THE FISCAL YEAR ENDED JUNE 30, 1904.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1903.				
July 6	Concrete	Oliver Iron Mining Co	Duluth	Minn.
	Sandstone	The Tenino Stone Quarries	Tenino	Wash.
	Wire rope socket	John Cashman	Quincy	Mass.
10	Brazed band steel	E. C. Atkins & Co	Indianapolis	Ind.
22	Bronze	The Victor Metals Co	East Braintree	Mass.
Aug. 3	Belting	Revere Rubber Co	Chelsea	Mass.
8	do	The American Belting Co	Youngstown	Ohio.
11	Bronze	The Victor Metals Co	East Braintree	Mass.
12	Chain	Harrington, King & Co	Boston	Mass.
	Stay bolt iron	Houghton & Richards	do	Mass.
18	Steel	Rapid Transit Subway Construction Co.	New York	N. Y.
29	Malleable iron	Rhode Island Malleable Iron Works.	Hill Grove	R. I.
Sept. 4	Trap rock	Hugh Martin	Woburn	Mass.
	Cement	Boston Transit Commission	Boston	Mass.
5	do	do	do	Mass.
8	Granite	Winnsboro Granite Co	Charleston	S. C.
	Concrete	S. E. Thompson	Newton	Mass.
9	Steel	Savage Arms Co	Utica	N. Y.
	Twisted steel bars	Ransome Concrete Machinery Co.	New York	N. Y.
11	Steel	Tremont Nail Co	West Wareham	Mass.
12	Eye bolt	J. H. Williams & Co	Brooklyn	N. Y.
	Bronze	Builders Iron Foundry	Providence	R. I.
22	do	The Victor Metals Co	East Braintree	Mass.
25	Chain	Brown & Sharpe Manufacturing Co.	Providence	R. I.
28	Brick	New England Brick Co	Boston	Mass.
	do	Frank B. Gilbreth	do	Mass.
	Concrete	Boston Transit Commission	do	Mass.
29	do	do	do	Mass.
	do	S. E. Thompson	Newton	Mass.
Oct. 9	Links	The Marine Hardware and Equipment Co.	South Portland	Me.
	Nails in wood	Hood Rubber Co	Watertown	Mass.
22	Tie rods	Boston Transit Commission	Boston	Mass.
23	do	do	do	Mass.
24	do	do	do	Mass.
28	Bronze	The Victor Metals Co	East Braintree	Mass.
29	Rope	Albert Winslow & Co	Boston	Mass.
31	Belting	The American Belting Co	Youngstown	Ohio.
	Steel bars	Boston Transit Commission	Boston	Mass.
Nov. 7	Cordage	New Bedford Cordage Co	New Bedford	Mass.
14	Bricks	New England Steam Brick Co	Providence	R. I.
	do	United States Express Co	Washington	D. C.
	Stone	Tufa Stone Co	Douglas	Ariz.
	Hemp rope	Albert Winslow & Co	Boston	Mass.
16	Steel	General Electric Co	Lynn	Mass.
23	Piston rods	Otis Elevator Co	Yonkers	N. Y.
25	do	do	do	N. Y.
26	do	do	do	N. Y.
28	do	do	do	N. Y.
30	do	do	do	N. Y.
Dec. 3	White iron	Sidney Eastman	Chicago	Ill.
	Concrete prisms	Boston Transit Commission	Boston	Mass.
4	do	do	do	Mass.
8	Concrete	S. E. Thompson	Newton	Mass.
11	Columns	Lally Patent Column Co	Waltham	Mass.
12	Steel bars	C. H. Cowdrey Machine Co	Fitchburg	Mass.
17	Bronze	The Victor Metals Co	East Braintree	Mass.
18	Turnbuckle	The Carson Trench Machine Co.	Boston	Mass.
	Shackles	Boston and Lockport Block Co	do	Mass.
19	Bronze	The Victor Metals Co	East Braintree	Mass.
28	do	Taunton-New Bedford Copper Co.	Taunton	Mass.
30	Steel	The Orford Copper Co	New York	N. Y.
	Manila rope	Standard Rope and Twine Co	Boston	Mass.
1904.				
Jan. 6	Brick	Eastern Sandstone Brick Co	do	Mass.
13	Bronze	The Victor Metals Co	East Braintree	Mass.
18	do	do	do	Mass.
23	Belting	Revere Rubber Co	Chelsea	Mass.
25	do	do	do	Mass.

PRIVATE TESTS—Continued.

TESTS MADE FOR PRIVATE PARTIES DURING THE FISCAL YEAR ENDED JUNE 30, 1904—Continued.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1904.				
Jan. 25	Wire rope	Wright Wire Co	Boston	Mass.
27	Steel hooks	The Thomas Laughlin Co	Portland	Me.
Feb. 4	Steel specimens	I. G. Johnson & Co	Spuyten Duyvil	N. Y.
9	Stone	Walter W. Ife	New York	N. Y.
10	Chain	Geo. W. Bush	Boston	Mass.
	Links	The Thomas Laughlin Co	Portland	Me.
	Steel balls	Waltham Manufacturing Co	Waltham	Mass.
18	Cast iron	Farrel Foundry and Machine Co	Ansonia	Conn.
	Bronze	The Victor Metals Co	East Braintree	Mass.
27	do	do	do	Mass.
	Steel bars	I. G. Johnson & Co	Spuyten Duyvil	N. Y.
	Steel bar	Savage Arms Co	Utica	N. Y.
29	Steel bridge rods	The New York, New Haven and Hartford Railroad Co.	Boston	Mass.
	Tackle blocks	Boston and Lockport Block Co	do	Mass.
Mar. 2	Wrought iron	Kinsley Iron and Machine Co	Canton	Mass.
7	Cast iron	Harold L. Bond Co	Boston	Mass.
8	Bronze	The Victor Metals Co	East Braintree	Mass.
14	Steel specimens	Wyman & Gordon	Worcester	Mass.
16	do	I. G. Johnson & Co	Spuyten Duyvil	N. Y.
	do	Eugene Childs	Roxbury	Mass.
	do	Savage Arms Co	Utica	N. Y.
19	Cast iron	Farrel Foundry and Machine Co	Ansonia	Conn.
30	Steel specimens	Wyman & Gordon	Worcester	Mass.
Apr. 6	Twine	Hood Rubber Co	Watertown	Mass.
14	Steel bars	Farrel Foundry and Machine Co.	Ansonia	Conn.
25	Sandstone	Michigan Lake Superior Power Co.	Sault Ste. Marie	Mich.
	Bricks	The Buffalo Sandstone Brick Co.	Buffalo	N. Y.
	Hydraulic gauges	The American Steam Gauge and Valve Works.	Boston	Mass.
	Columns	Lally Patent Column Co	Waltham	Mass.
26	do	do	do	Mass.
	Bricks	Southern Tile and Brick Works	Jackson	Tenn.
27	Steel specimens	Wyman & Gordon	Worcester	Mass.
May 7	Bronze	Taunton-New Bedford Copper Co.	Taunton	Mass.
9	Steel bars	The Marlin Firearms Co	New Haven	Conn.
	do	Boston Transit Commission	Boston	Mass.
10	do	do	do	Mass.
11	Cloth	Hood Rubber Co	Watertown	Mass.
12	Paving brick	City of Cambridge	Cambridge	Mass.
13	do	do	do	Mass.
	Cloth	Union Carpet Lining Co	Boston	Mass.
17	Bronze	Taunton-New Bedford Copper Co.	Taunton	Mass.
23	Shackles	Fletcher & Crowell Co	Portland	Me.
	Tackle blocks	Boston and Lockport Block Co	Boston	Mass.
24	Manila rope	Fearing, Whiton & Co	do	Mass.
	do	Plymouth Cordage Co	North Plymouth	Mass.
25	Hoisting hook	J. H. Williams & Co	Brooklyn	N. Y.
	Steel specimens	I. G. Johnson & Co	Spuyten Duyvil	N. Y.
	Wrought iron	Kinsley Iron and Machine Co	Canton	Mass.
	Brazed band steel	E. C. Atkins & Co	Indianapolis	Ind.
26	Cloth	Hood Rubber Co	Watertown	Mass.
	Wrenches	A. J. Wilkinson & Co	Boston	Mass.
June 2	Shackle	Fletcher & Crowell Co	Portland	Me.
3	Twine	Hood Rubber Co.	Watertown	Mass.
4	Granite	Balfour Quarry Co	Salisbury	N. C.
7	Brick	National Art Stone Co	Chester	Pa.
	do	Gustave Loeb	New York	N. Y.
	Steel	American and British Manufacturing Co.	Bridgeport	Conn.
9	Steel and wrought iron.	Pacific Mills	Lawrence	Mass.
16	Granite	City of Cincinnati	Cincinnati	Ohio.
17	Hemp rope	Albert Winslow & Co	Boston	Mass.
20	Bronze	The Victor Metals Co	East Braintree	Mass.
21	Steel	Wyman & Gordon	Worcester	Mass.
22	Rubber	Hood Rubber Co	Watertown	Mass.
23	Belting	Boston Woven Hose and Rubber Co.	Boston	Mass.
	Links	S. C. Rowell & Co	do	Mass.
28	Swivel	Fletcher & Crowell Co	Portland	Me.
29	Cement blocks	Cement Machinery Co	Jackson	Mich.

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